ECHNOLOGY DEPT.

POWER

OCTOBER, 1943

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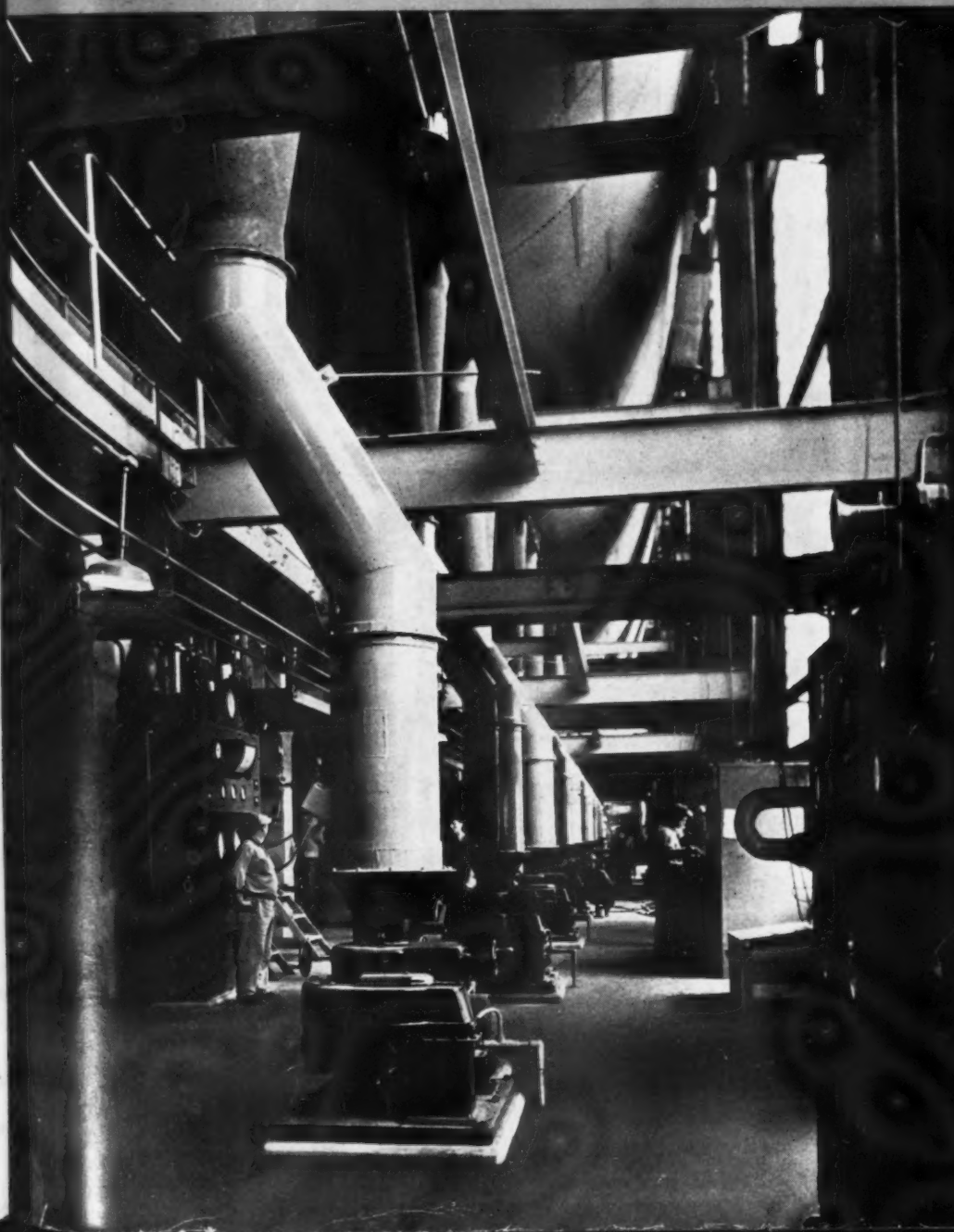
DETROIT

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY



Modern boilers, burning blast-furnace gas and supplementary fuels separately and in combination, bring high efficiency to steel-mill power plants. For full details on latest developments in furnaces, superheaters, combustion control, fuels, fans and burners, turn to pg 64

Lubrication keeps chain drives fit — here's what you need to know for a good job: what grade lubricant to use and how to apply it, for detachable-link, roller and silent chains, for low- or high-speed operation. Story starts pg 103

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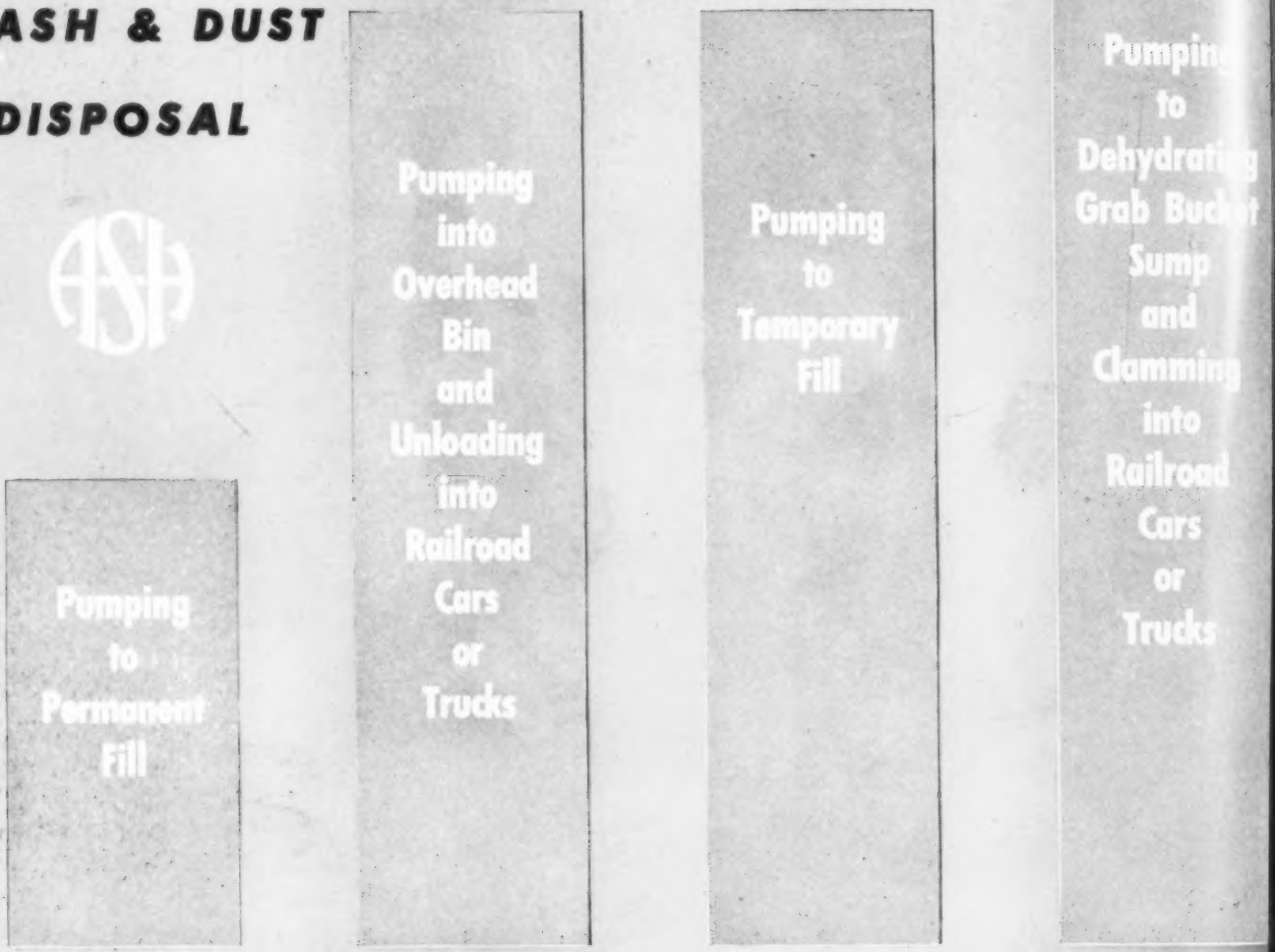
Page 59

Firing aisle in butadiene-styrene plant at Institute, W. Va., operated by Carbide and Carbon Chemicals Corp

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

COMPARATIVE OPERATING COSTS OF VARIOUS METHODS ASH & DUST DISPOSAL


ASH
Pumping to Permanent Fill
Pumping into Overhead Bin and Unloading into Railroad Cars or Trucks
Pumping to Temporary Fill
Pumping to Dehydrating Grab Bucket Sump and Clamming into Railroad Cars or Trucks

The Exceptional Case where "Cheapest is Best"

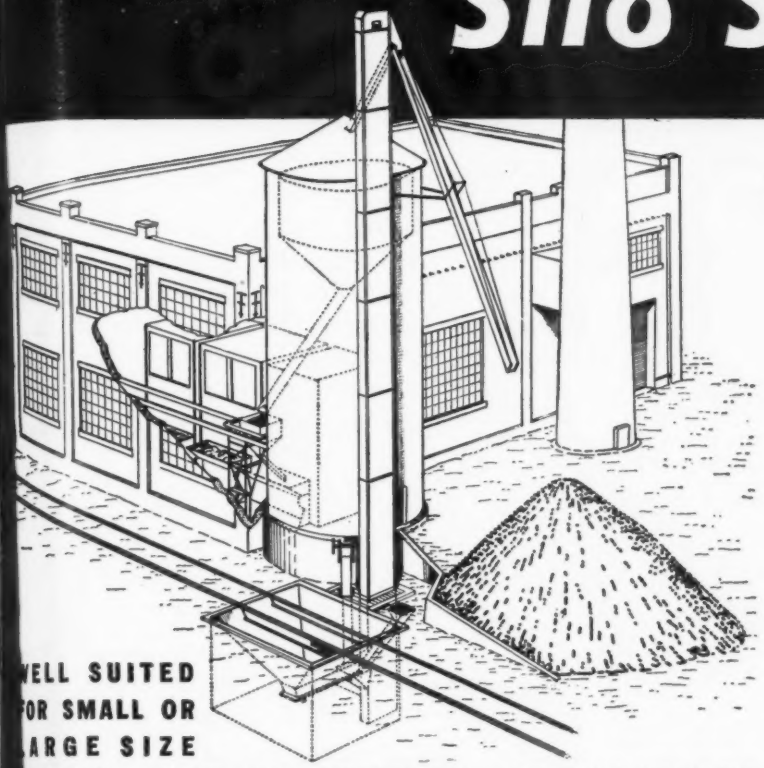
Pumping Ashes to a Permanent Fill, by means of a Hydroseal Ash Pump, is unquestionably the cheapest, simplest and the "best method" for the final disposal of ashes or dust. No labor is required, aside from starting and stopping the pump. The pipe line carries the refuse where you want it, which may be a mile or more from the plant. Strikes, labor shortage or scarcity of railroad cars or trucks for hauling the refuse cannot tie-up plant operation. In addition, absolute cleanliness is assured by this totally enclosed system. The ashes and dust form a hard packed, almost level fill, while the water leeches into the ground or may be recirculated if required. . . . Where there is no property available for permanent fill, it is evident that the refuse must be moved away by trucks or railroad cars. The problem then resolves itself into the selection of the most reliable and cheapest means of accomplishing this rehandling and transportation. Two methods are standard: (1) Pumping to temporary fill, with four to six months' storage. This scheme has the advantage of allowing rehandling and transporting on a mass production basis and at a time when weather and labor conditions are most suitable. (2) Providing two or three days' storage adjacent to the plant, either by pumping to Hydro-Bin, which can be unloaded into trucks or railroad cars by gravity, or by pumping or sluicing to ash storage sump which must be later unloaded by a crane operator. . . . Our engineers will assist in the solution of your "present" or "future" ash disposal problems. Send for Catalog No. 141.

Hydroseal Ash Pumps

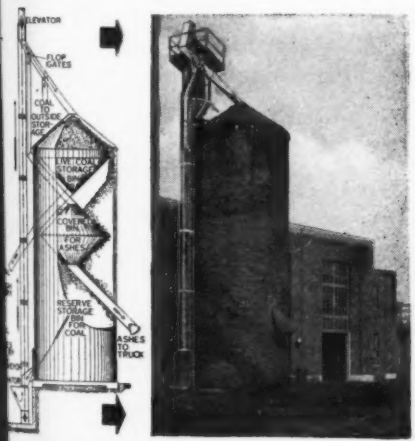
ALLEN-SHERMAN-HOFF CO., 227 S. 15th St., PHILADELPHIA 2, PA. *Offices & Representatives in Principal Cities*

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"). October, 1943, Vol. 87, No. 10. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive offices, 330 West 42nd Street, New York, N. Y. Entered as second class matter August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

COAL AND ASHES HANDLING SIMPLIFIED WITH THE Silo System



WELL SUITED FOR SMALL OR LARGE SIZE PLANTS — NEW OR EXISTING INSTALLATIONS



Both coal and ashes are handled here. Coal may be diverted to ground storage through an auxiliary spout. Ashes are discharged to the ashes section of the silo by means of a control gate and independent spout.

Another typical silo installation handling coal only, but without auxiliary ground storage. Coal from the live storage hopper in the silo is spouted directly to pulverizers located inside the building.

Combines Supply and Handling Functions in One Compact Economical Unit

Usually silos are located adjacent to the boiler house but constructed independently, and equipment within the boiler house consists entirely of means for distributing the coal. Frequently a single spout from the silo is all that is needed. Silos may be designed for normal storage requirements or equipped with an auxiliary spout to provide additional outside reserve storage when desired. This system may be arranged to store both coal and ashes. The installation shown above handles coal only, supplying the boiler house from active and reserve storage within the silo and storing out additional reserve ground storage. A traveling weigh larry receives coal from the live storage hopper of the silo and distributes it to the stokers. Talk over your problems with our experienced engineers.

LINK-BELT COMPANY

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... Coal And Ashes Handling Equipment

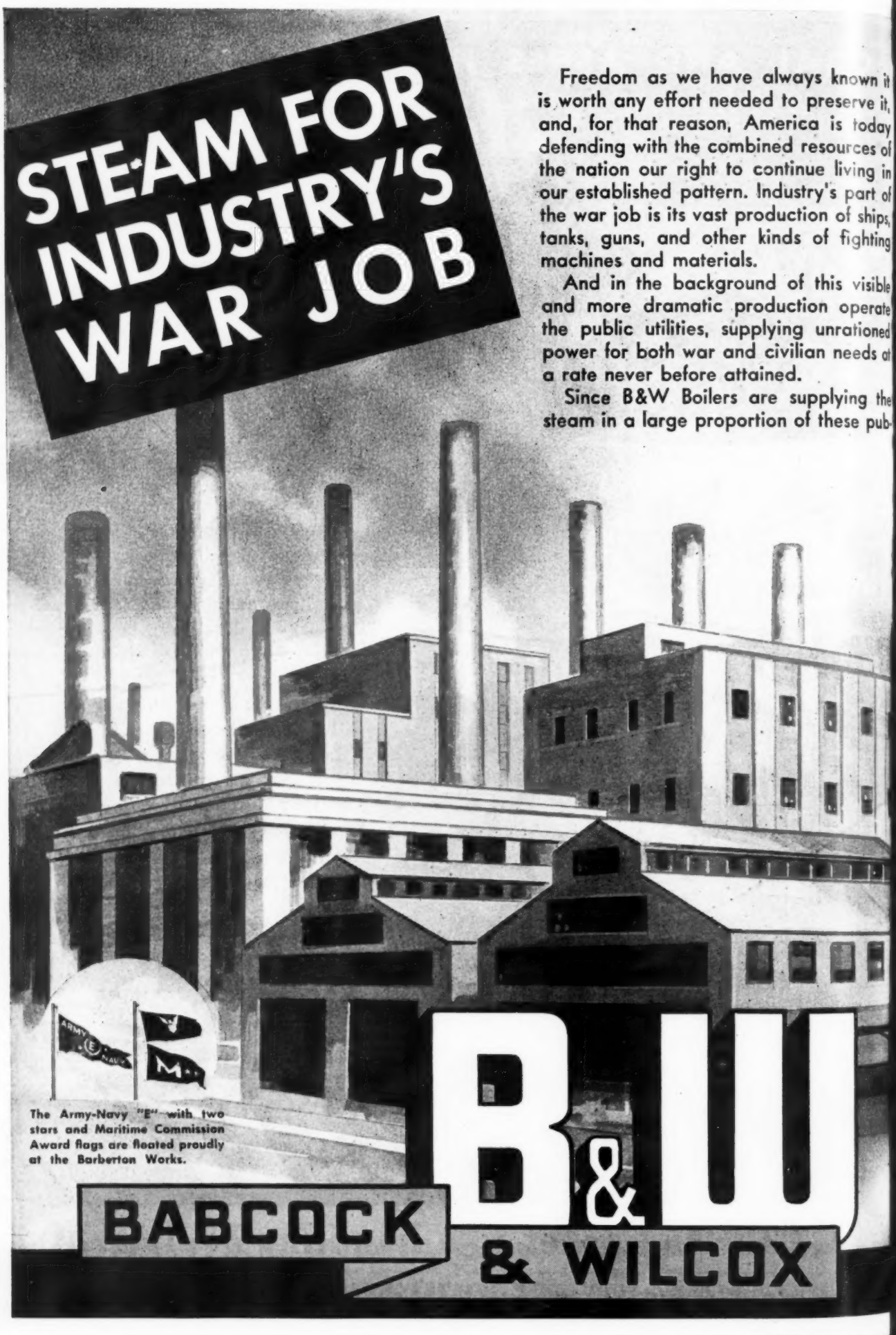
CONVEYORS • ELEVATORS • SKIP HOISTS • CRUSHERS • LARRIES • SCREENS

STEAM FOR INDUSTRY'S WAR JOB

Freedom as we have always known it is worth any effort needed to preserve it, and, for that reason, America is today defending with the combined resources of the nation our right to continue living in our established pattern. Industry's part of the war job is its vast production of ships, tanks, guns, and other kinds of fighting machines and materials.

And in the background of this visible and more dramatic production operate the public utilities, supplying unrationed power for both war and civilian needs at a rate never before attained.

Since B&W Boilers are supplying the steam in a large proportion of these pub-



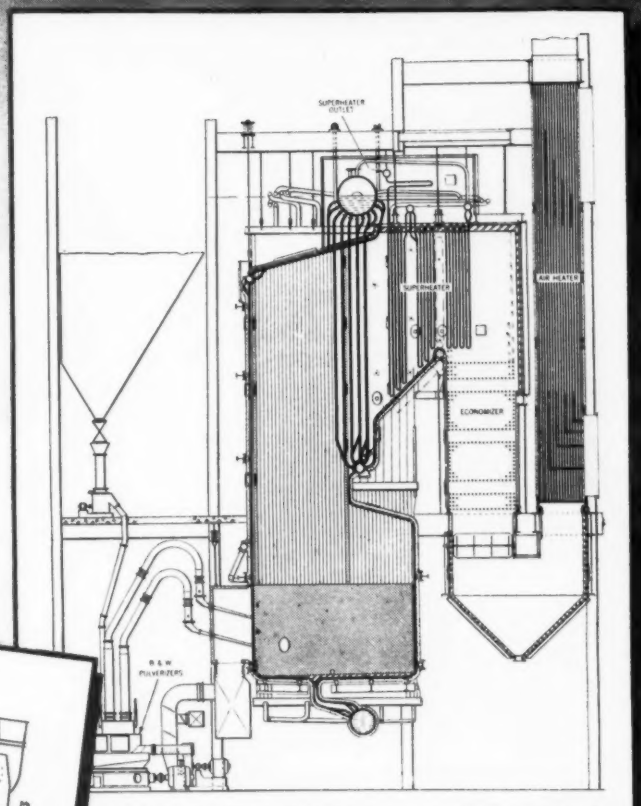
The Army-Navy "E" with two stars and Maritime Commission Award flags are floated proudly at the Barberton Works.

BABCOCK & WILCOX

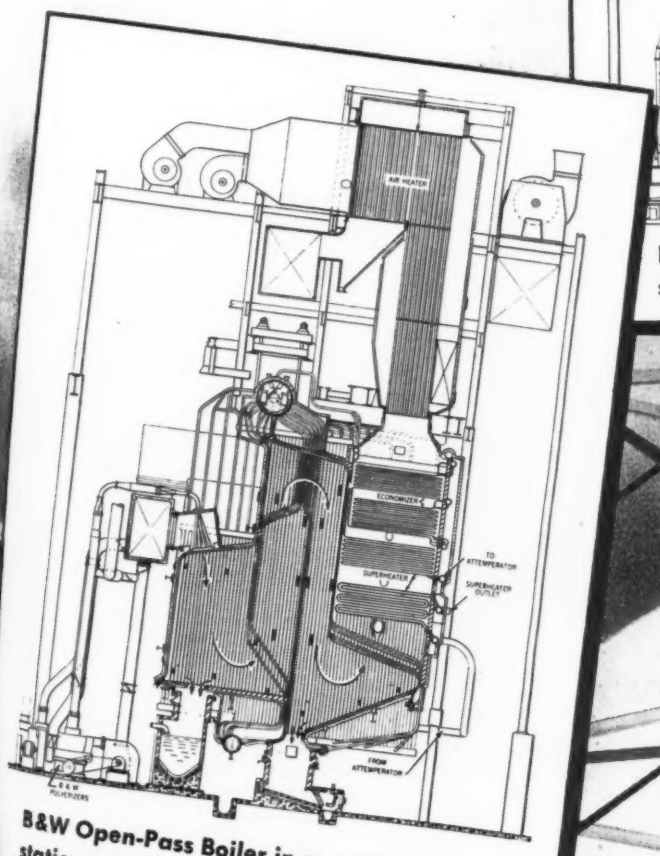
B&W

lic utility and industrial power plants, and for propelling naval and cargo ships, B&W is playing a substantial part in this great war effort. B&W engineering and production skill have built into its boilers the stamina to endure today's gruelling drive.

With today's accelerated experience yielding more complete answers to such problems as behavior of metals at high temperatures, action of fuels in slag-tap and dry-ash furnaces, circulation in high-capacity high-pressure boilers, separation of steam from water in boiler steam drums, and other related problems, the boilers of tomorrow should be even better able to serve industry.



B&W Radiant Boiler in an eastern central station—Capacity 400,000 lb. steam per hr.



B&W Open-Pass Boiler in an eastern central station—Capacity 350,000 lb. steam per hr.

THE BABCOCK & WILCOX COMPANY
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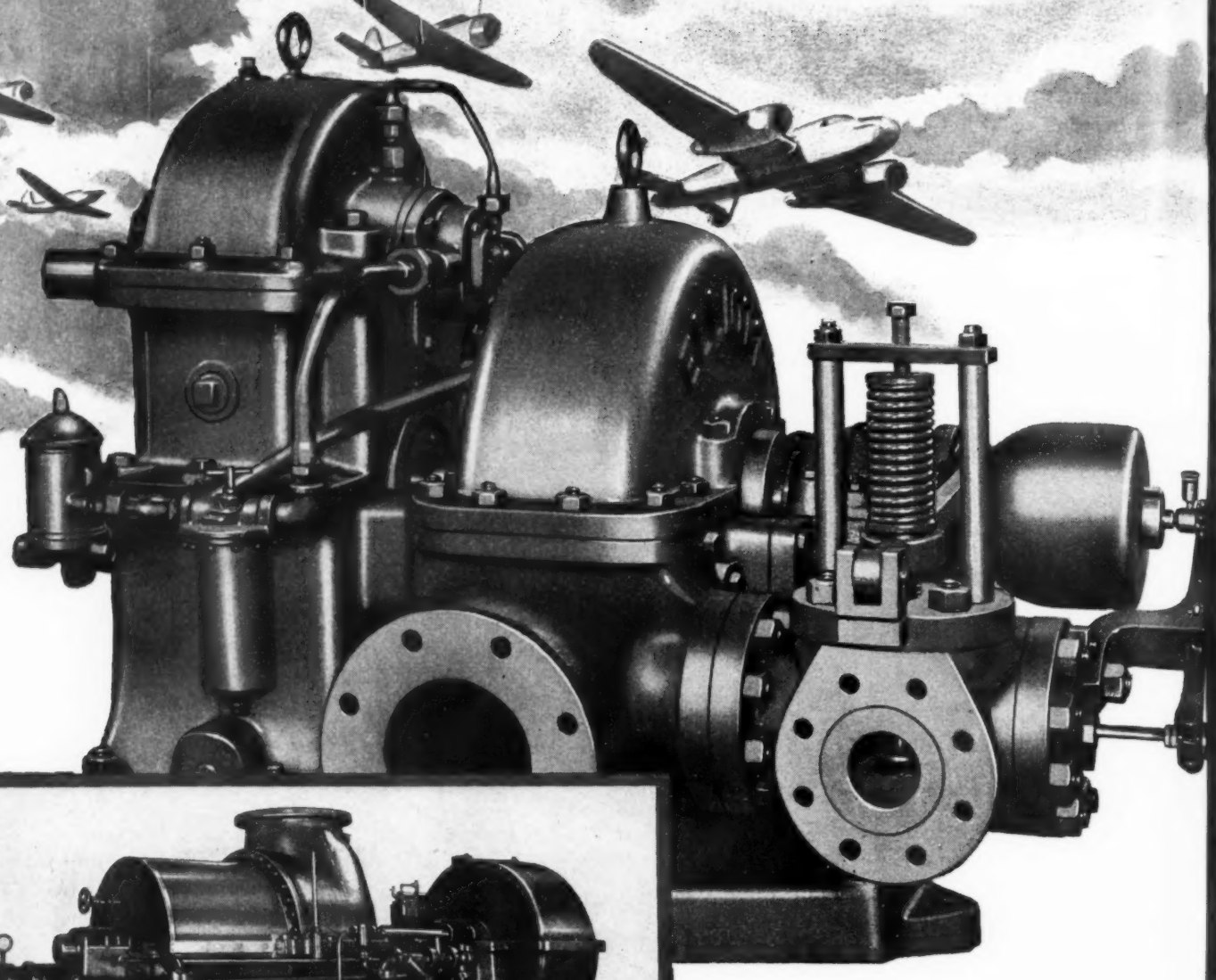
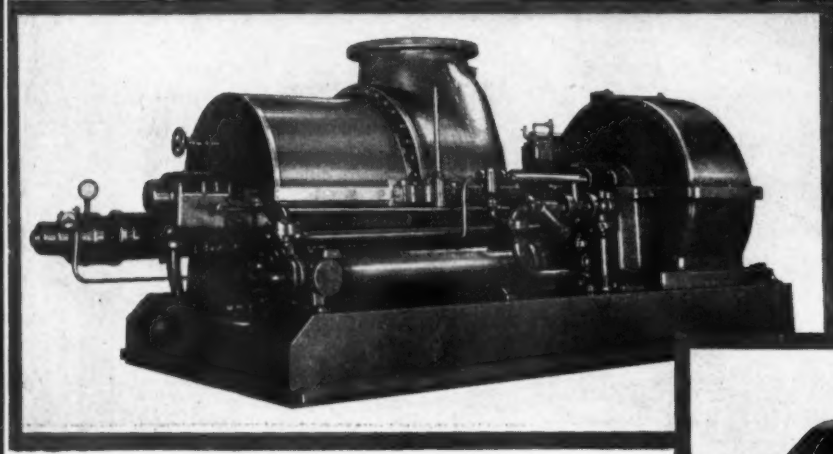
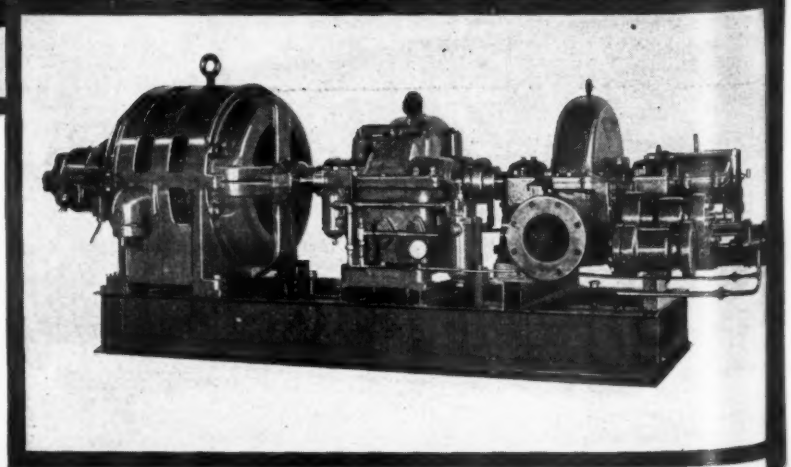
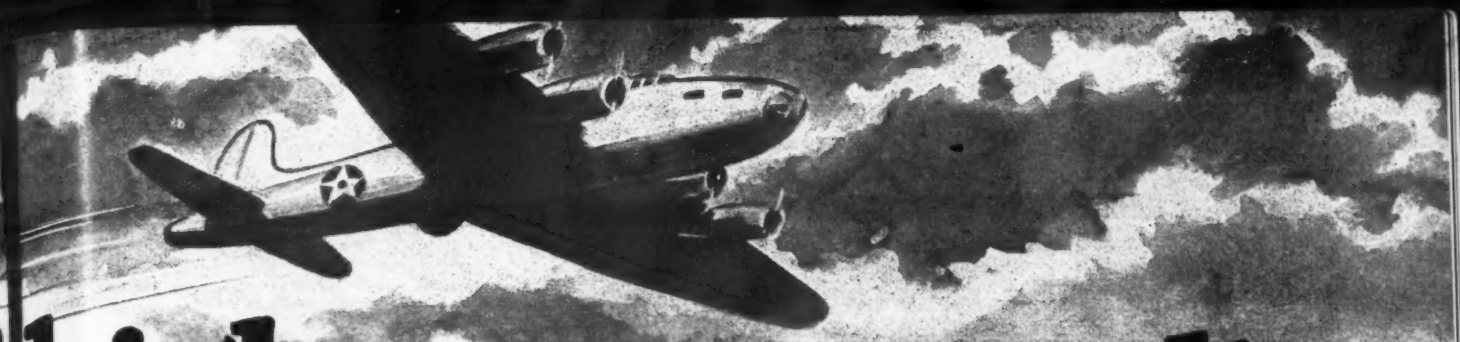
It's a matter of h







The large photo above shows the Elliott mechanical drive turbine with built-in reduction gearing. This type of unit is in wide use. The two smaller photos show larger units, the gear assembly being coupled.



high-octane gasoline

The thundering skies over Nazidom grow ominously blacker, in spite of U-Boats, "flak", and enemy fighter planes. America's high-octane "gas" is largely powering the rain of destruction now blasting the industrial heart of enemy Europe.

The production of this Victory-making gasoline utilizes numbers of Elliott mechanical drive turbines, many with accompanying reduction gears. These units are used on refinery pumps everywhere, as well as in power plant drives for fans, pulverizers, and in units for the process industries making explosive components. Gears are used wherever the driven member operates at a speed other than the best operating speed of the turbine.

Elliott mechanical drive turbines are universally favored as sturdy, dependable drive units. Where geared reduction is needed, Elliott builds both gear and turbine, the two elements being separate in the larger sizes, but in smaller sizes the gears are built-in and actually part of the turbine assembly in a compact, space-saving unit. Gears are of approved tooth form adhered to with extreme accuracy, thus insuring maximum quietness in operation.

If you have an application for a direct-connected or geared turbine, Elliott has the unit to fit. Write us.

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GEARED TURBINES

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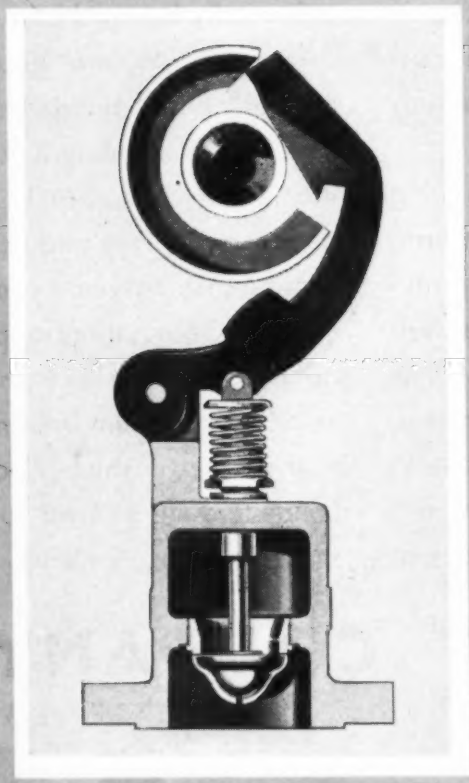
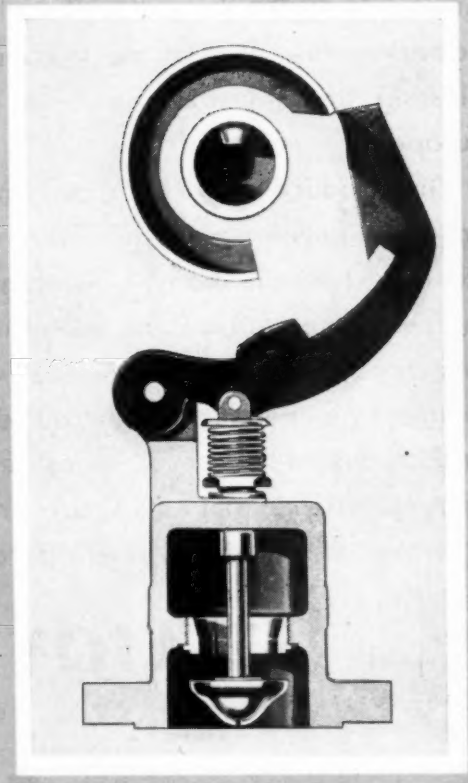
FOR BETTER BOILER CLEANING

Check SOOT BLOWER CAM SETTINGS PERIODICALLY

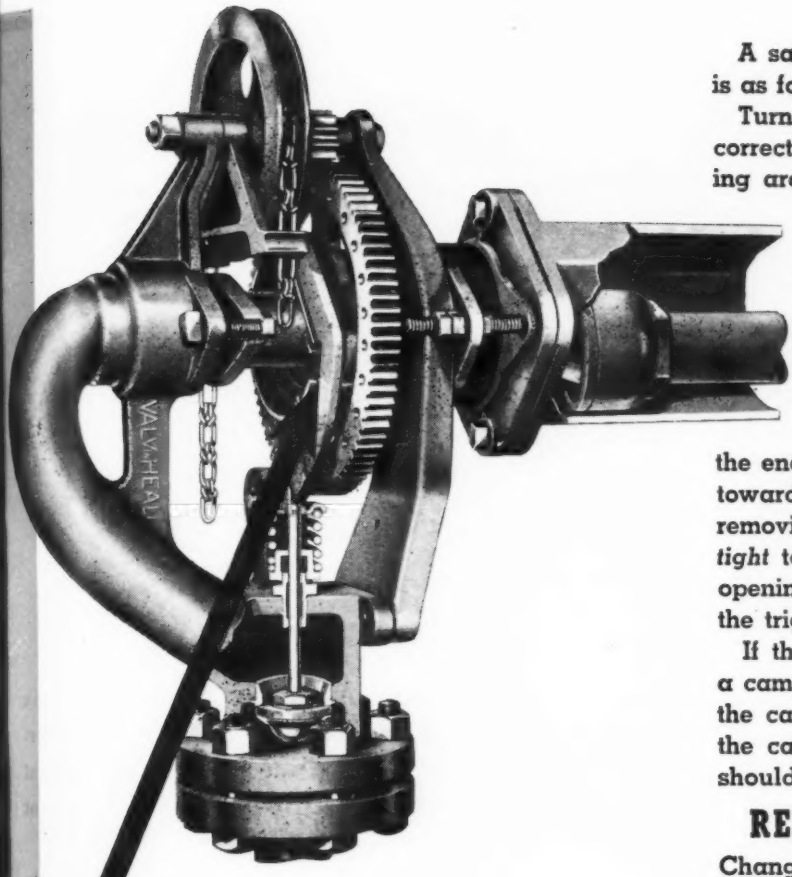


Position of cam and trigger of Diamond G9B Soot Blower just prior to beginning of blowing. Clockwise rotation of the cam will depress the trigger and open the valve.



Trigger is now completely depressed and valve is open. Length of cam determines blowing arc as valve remains open until trigger slips off other end of cam.

THROW YOUR *Scrap* INTO THE FIGHT



A MOST IMPORTANT PART of the Diamond G9B Soot Blower is the cam which opens and closes the valve—and which regulates the pressure where reduced pressure blowing is employed.

In any case, the cam determines the blowing arc. If it is not properly set, the blowing arc will be wrong. If the arc is too long, steam is wasted, and tubes, headers, baffles, etc., may be injured. If the arc is too short, effective cleaning is impossible.

Cams on all G9B heads should be examined periodically for tightness and correct position. Drawings furnished for installation of Diamond Soot Blowers show the correct blowing range for each unit. It is important that nozzles should not blow directly into boiler headers, drums, baffles, etc., at close range with full pressure.

A safe method for checking or setting cams is as follows:

Turn the element so that the nozzles are in correct position for the beginning of the blowing arc. With the head in this position, place the opening end of the cam (the beveled end with the slot in it) in contact with the end of the trigger. Then attach the cam to the gear wheel by means of two cam bolts made up handtight, and turn the head until the nozzles are in correct position for the end of the blowing arc. Mark the cam directly at the end of the trigger, and cut it off 2¼" back toward the beveled end from this point after removing it from the gear wheel. Then bolt *tight* to the gear wheel, making sure that the opening end of the cam comes in contact with the trigger first.

If the blowing arc is so short as to require a cam 3" long or less, cut off only the face of the cam and leave at least five bolt holes in the cam flange. Not less than two cam bolts should be used.

REDUCED PRESSURE BLOWING

Changes in baffles, etc., may require reduced pressure blowing through part of the arc. Special cams should be used to provide any needed sequence of reduced and full pressure blowing.

360° ARC BLOWING

Some conditions require a unit to blow through the entire revolution. In such cases, 360° cams and triggers should be used.

GET *MORE* OUT OF THE SOOT BLOWERS YOU HAVE

War demands often make it difficult for us to supply new blowers or repair parts as promptly as we'd like. Careful maintenance will prolong the useful life of the blowers you have. This booklet tells you how to maintain, adjust and repair Diamond G9B Soot Blowers. *Write for a copy.*

DIAMOND POWER SPECIALTY CORP.

DETROIT • MICHIGAN

DIAMOND SPECIALTY LIMITED • Windsor, Ontario

TAYLOR STOKERS Keep Steady Pressure on Dancing Steam Flow

YOU'VE SEEN enough of these steam flow charts to recognize this one—from another famous war plant—as a steam hammer load. But while the flow pen jiggles all over the chart, the pressure pen holds a strong, firm course.

The charts were taken from recorders on the latest of six Taylor Stokers (installed last year) in a metal-working plant—a six Retort stoker under a 628 H. P. boiler, burning high volatile coal and operating at an efficiency of 78 to 80% without any heat recovery equipment.

Once again Taylor Stokers demonstrate their ability to operate efficiently, and maintain even pressure on severely varying loads.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.

2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.

4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. **EFFICIENCY**—the proved **dollar** efficiency (**total** cost of steam production) as shown by actual performance in similar installations.

6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

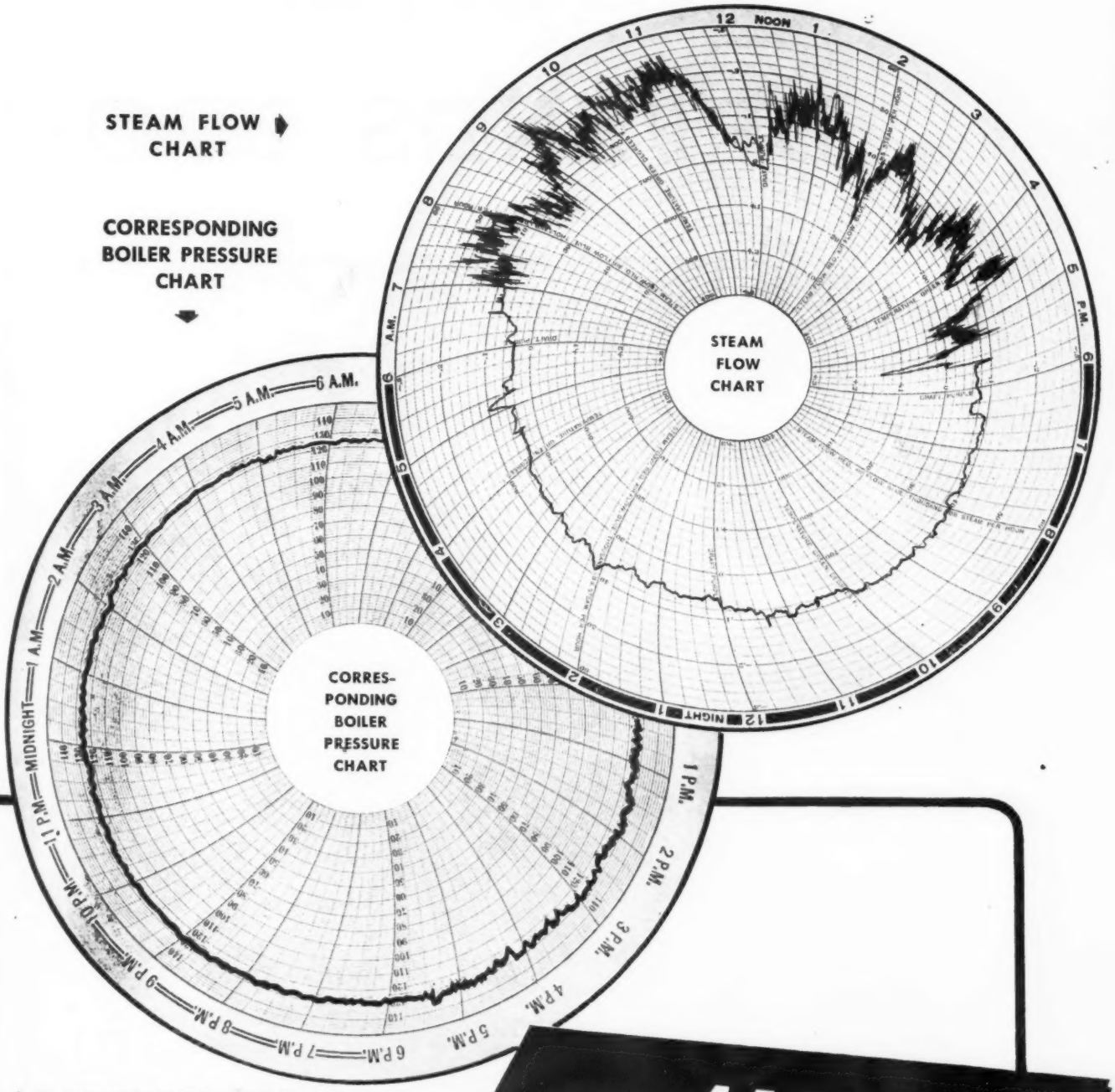
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.

11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. **OBSOLESCENCE**—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA



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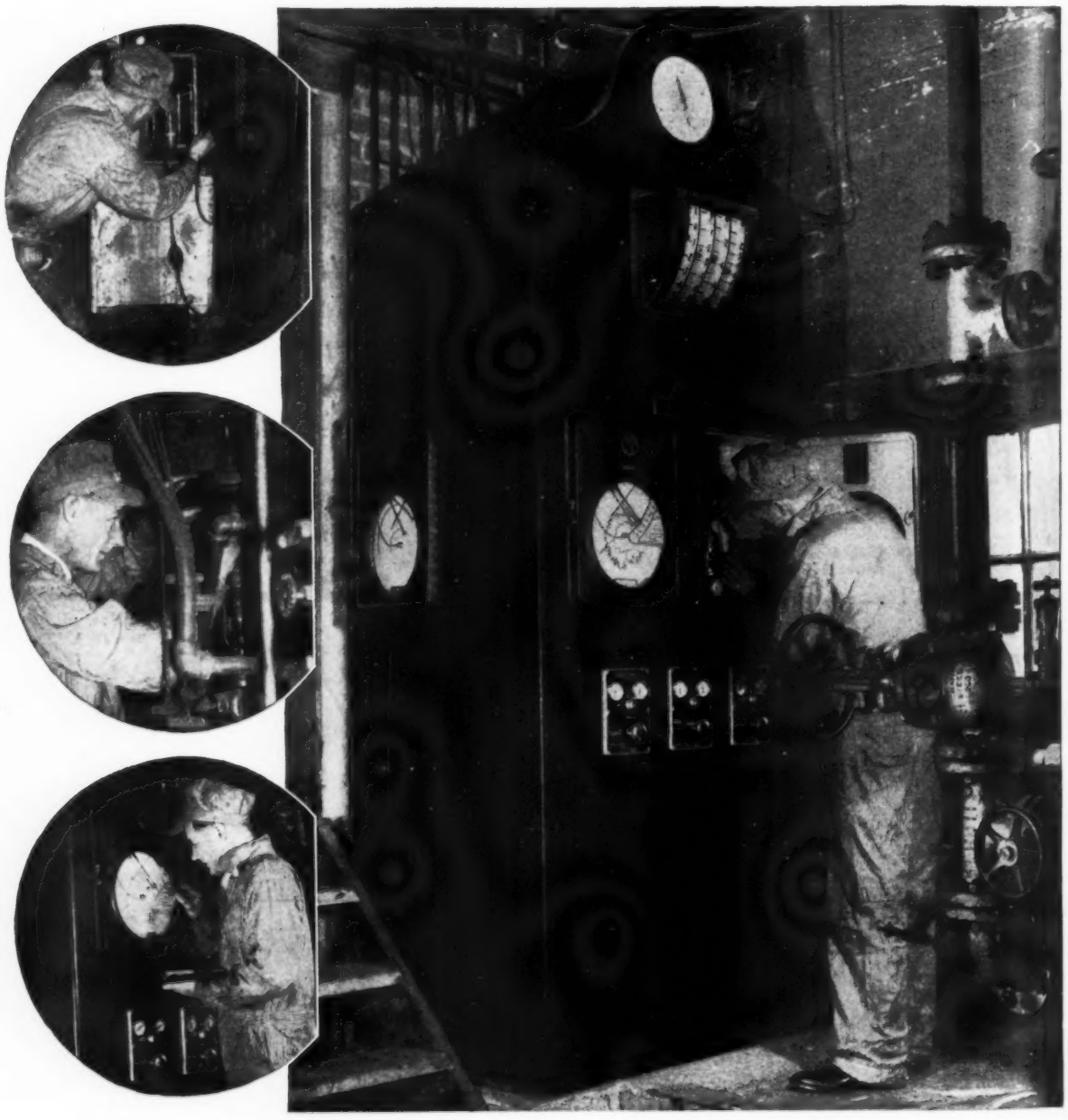
EFFECTIVE

DEPENDS UPON



Bailey Field Engineers who are specialists in combustion testing and boiler control, carefully adjust each Bailey Boiler Meter and Control System to its boiler unit. This method of application insures maximum effective performance of metering and control equipment.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

INSTRUMENTATION ENGINEERING

★ It is relatively easy to construct a ratio meter for the measurement of Steam Flow and Air Flow; but to properly apply it to a steam generating unit requires experienced, competent engineering service. Successful application depends upon skill in making the combustion tests which determine the final setting of the meter.

The Bailey Engineering Organization, which includes graduates from over 40 different Engineering Schools, has grown up with the modern boiler plant. Over 25 years ago, when units were small and crude compared to those available today, Bailey Engineers served the industry by conducting combustion tests and adjusting Bailey Boiler Meters to guide the way to maximum combustion economy. Since then, boilers and furnaces have seen many improvements and Bailey Engineers have been constantly in close contact with their development. This experience has yielded a store of "know how" which is now drawn on by Bailey Engineers in their work of adjusting metering and control equipment for optimum results. All graduate Engineers entering the employ of Bailey Meter Company receive a factory training course which includes comprehensive post graduate studies in combustion and boiler control.

Bailey Meter Company has its Engineers permanently located in over 30 cities throughout the United States and Canada. These Engineers concentrate exclusively on the application and adjustment of Bailey Meters and Control Systems. Their activities are directed by Bailey branch office managers who are well qualified Combustion Engineers of long experience. Most of these managers have been associated with the Company for over twenty years.

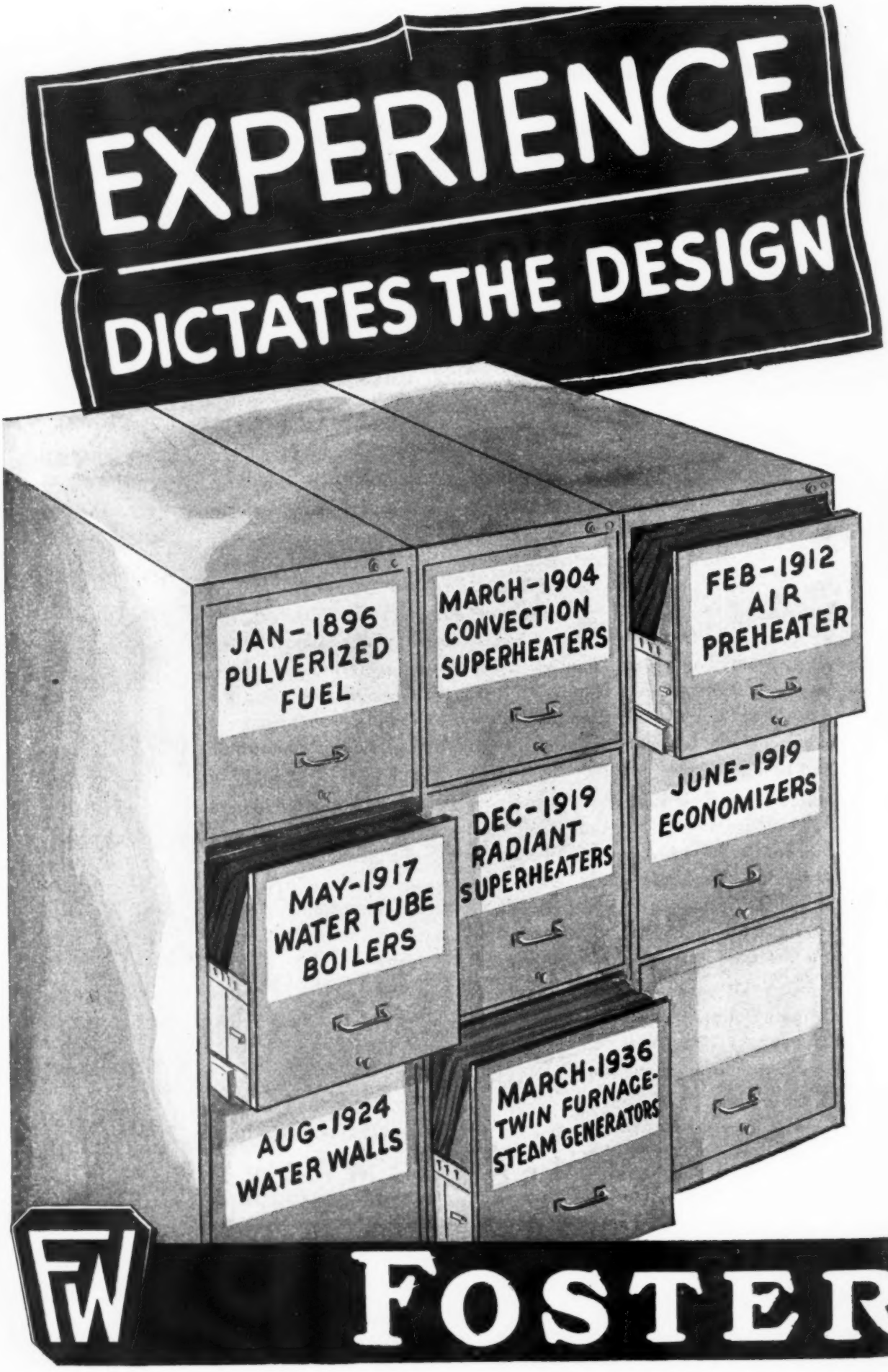
Through this seasoned field engineering organization, Bailey Meter Company offers Power Engineers a safe, sure way to maximum boiler steaming capacity, fuel economy, conservation of man power, and minimum outage of equipment.

For an outline of the many ways in which Bailey Meters and Control Systems serve the modern steam plant, ask for a copy of Bulletin No. 15-B.

BAILEY METER COMPANY
1036 IVANHOE ROAD CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada G-16

e Complete Combustion Control System

ROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL


EXPERIENCE
DICTATES THE DESIGN
JAN-1896 PULVERIZED FUEL
MARCH-1904 CONVECTION SUPERHEATERS
FEB-1912 AIR PREHEATER
DEC-1919 RADIANT SUPERHEATERS
JUNE-1919 ECONOMIZERS
MAY-1917 WATER TUBE BOILERS
AUG-1924 WATER WALLS
MARCH-1936 TWIN FURNACE-STEAM GENERATORS
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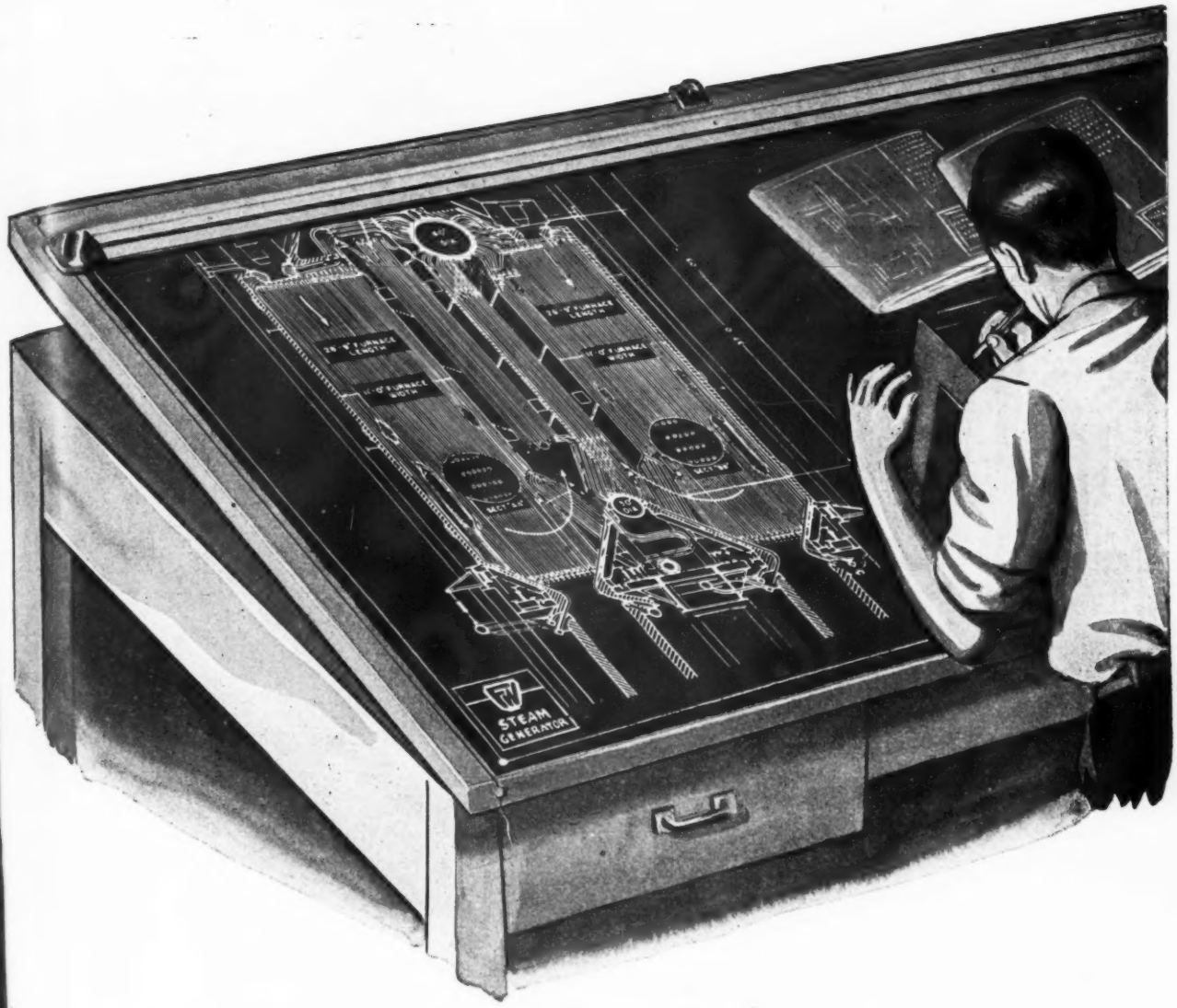

The prime requisite of EXPERIENCE—predominating factor in the successful engineering of any power plant —contributes exceptionally to designs developed by Foster Wheeler. Half a century of experience combined with efficient shops, progressive engineering, active research assures economic installation and operation.

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WHEELER FW

Sturtevant Equipment

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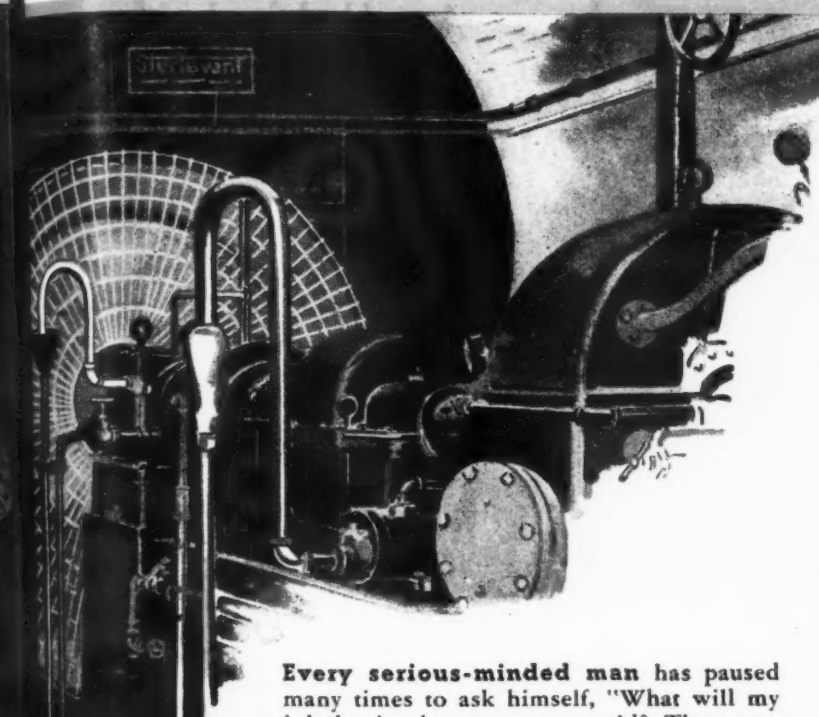
AND SYSTEMS

ENGINEERED FOR PRECISION-VENTILATING, HEATING, AIR CONDITIONING, DRYING
DUST AND FUME CONTROL, PNEUMATIC CONVEYING, MECHANICAL DRAF

in the post-war world!"



Every serious-minded man has paused many times to ask himself, "What will my job be in the post-war world? The exact answer, of course, cannot be known. But daily the pattern of shadows forecasting things to come grows more definite.

Men in the armed forces are already working with many of the epoch-making post-war products which will be the backbone of our peacetime rebuilding. Knowing the toll taken by long hours of overloading, you can start now to plan for your plant's post-war facilities. Sturtevant is in a position to pitch right in and help.

We can assure you that Sturtevant Fans and other Mechanical Draft Equipment will continue to meet your severest requirements . . . whether for highest speeds, largest volumes, highest pressures or temperatures. Tomorrow, as in the past, you can look to Sturtevant for the new techniques and improved equipment which will help you squeeze the last atom of energy out of your fuel.

AXIFLO . . . 40% SPACE SAVING

The Victory Axiflo Fan is an example. It's been called the most remarkable development in fan history. We are now building it only for U.S. warships, but later it will be available to you. Picture an axial flow fan that saves up to 40% in space and power, breaks 80 in decibel rating, works against pressures up to 60 inches water gauge. It is just waiting to get its teeth into some of your forced and induced draft problems.

Remember, much of America's equipment was old and worn even before the war started. Overworked by War's unremitting demands, equipment in many plants is now ready to be replaced by the last word in engineered air handling equipment and systems.

ENGINEERED AIR will make the difference...

Equipment that puts "Air to Work" more efficiently—not only to burn fuel but to ventilate, air condition, heat, dry, convey or control dust and fumes—will make the difference between profit and loss in many a post-war plant. A Sturtevant expert, working with your own post-war planning committee, is ready to find the solution to these air handling problems.

B. F. STURTEVANT COMPANY

Hyde Park, Boston, Mass. *Branches in 40 Cities*

B. F. Sturtevant Co. of Canada, Ltd., Galt, Toronto, Montreal

* *U. S. Patents No. 1,846,863: 1,989,413.*

Sturtevant

REG. U.S. PAT. OFF.

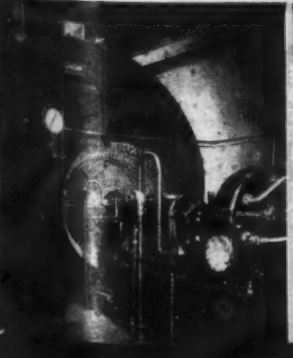
Puts Air to Work

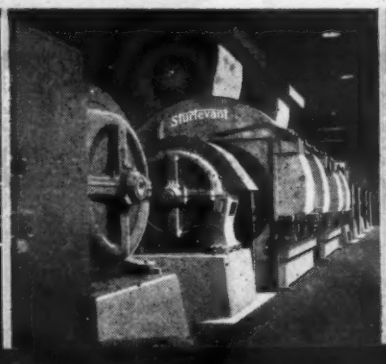
FORCED DRAFT—World's champion steam producer, 3 boilers, each rated 800,000 lb. per hour reached peak of 1,250,000 lb. with Sturtevant Fans, a world's record for East River Station, Consolidated Edison Co.

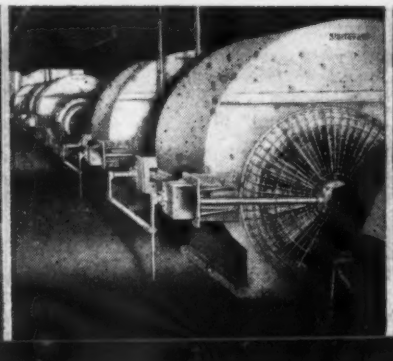
INDUCED DRAFT—World's largest installation, 47 Sturtevant Fans with capacity of 22 million pounds of gas and air per hour at Hudson Ave. Station, Brooklyn Edison Co.

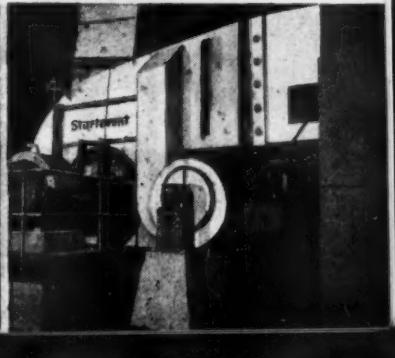
VANE CONTROL*—Like hundreds of other industrial and central station power plants, West Virginia Pulp and Paper Co., automatically control draft volume and pressure with Sturtevant Vane Control.

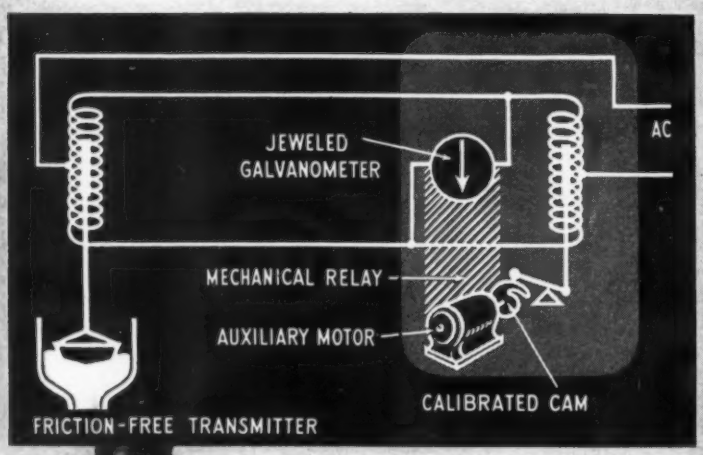
SAID FAN & COLLECTOR—Combined Fly Ash Collectors and Induced Draft Fans installed at Appalachian Electric Power Company, Cabin Creek, W. Virginia.



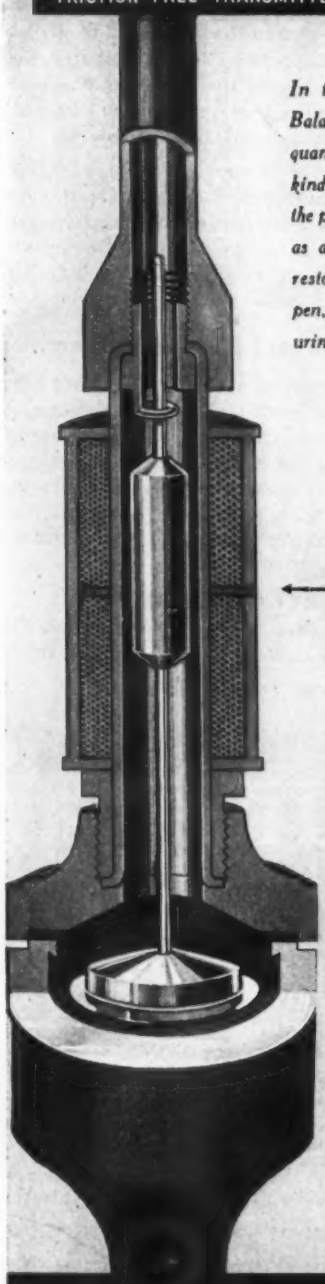








In the Cochrane Flow Meter, the Null or Zero Balance principle is employed, balancing the unknown quantity by adjusting a known quantity of the same kind. A highly sensitive detector is used to determine the point of balance. A friction-free transmitter serves as a pilot for an external motor drive. The motor restores the bridge to balance and operates recording pen, indicating pointer, and integrator. The measuring circuit is relieved of all work.



←It Floats!

The Cochrane Friction-Free Manometer

- No Bearings
- No Stuffing Box
- No Electric Contacts
- No Solenoid "Reaction"

This sensitive float acts as a pilot for the auxiliary motor drive, which operates with high and equal power throughout the entire scale.

7 Range Capacities Available in Cochrane Flow Meters.

The capacity of a Cochrane Flow Meter may be altered to meet varying conditions in 15 minutes' time. Two styles of transmitter are available, one of which provides five changes of manometer tube, ranging from 18 inches water differential through 42, 75, 117 to 169. The other style transmitter provides for seven ranges, five as above plus two additional of 230 and 301 inches water differential.

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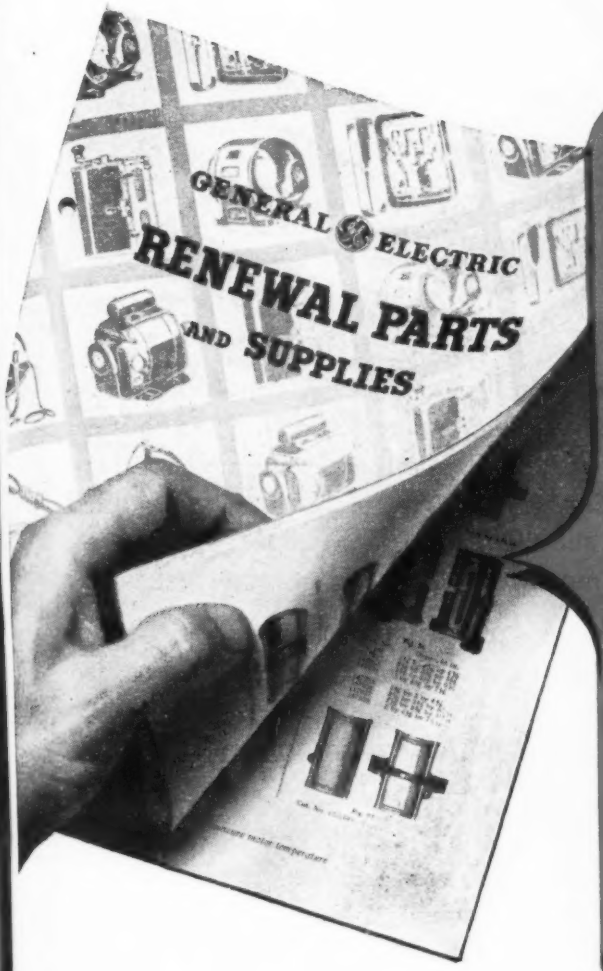
COCHRANE FLOW METERS

READY! Simplified Catalog of G-E Renewal Parts



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NOW, a single book—indexed for easy reference—can take the place of separate handbooks and bulletins for identifying and ordering most G-E renewal parts needed to keep your equipment in operation. With this book, you'll find it easier to order genuine G-E parts *by catalog number*—saving time all along the line.

For your copy, just mail the coupon. Even though you don't need it now, it may save precious hours in an emergency. *General Electric Company, Schenectady, N. Y.*

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General Electric Co., Section **AB 750-220**
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Yes, I want a copy of your new 96-page catalog "Renewal Parts and Supplies (GEA-638)" to help simplify ordering of genuine G-E parts.

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226

Right now, we're all too much occupied with the job of whipping the Axis to talk much about what we are doing.

We do think, however, that you should know a few FACTS about Axial Flow Fans. Urgently required for ship ventilation, for war production plant processes, for mobile power plants and other special applications, Axial Flow Fans have had ten years of normal development crammed into one year. Buffalo engineers working with Naval, Maritime and industrial engineers, developed a close-clearance design which provides higher operating efficiency, greater capacity, and unusual quietness; all this with more air delivered per kilowatt hour.

To withstand severe service conditions, heavier construction was provided. Then to meet ever-shortening delivery requirements, production schedules were constantly improved —in short *better* fans were built in *less* time— and more accurately—than ever before.

Buffalo Forge Company was the *first* manufacturer to receive the Army-Navy "E" Award for fans (Dec. 7th, 1942) and has since then been awarded renewal of this honor.

Buffalo Axial Flow Fans—"The fans with the Bee-line air route"—offer real advantage to Industry for Today's important work and Tomorrow's industrial development.

Write for this new booklet on Buffalo Axial Flow Fans just off the press . . .

BUFFALO FORGE COMPANY

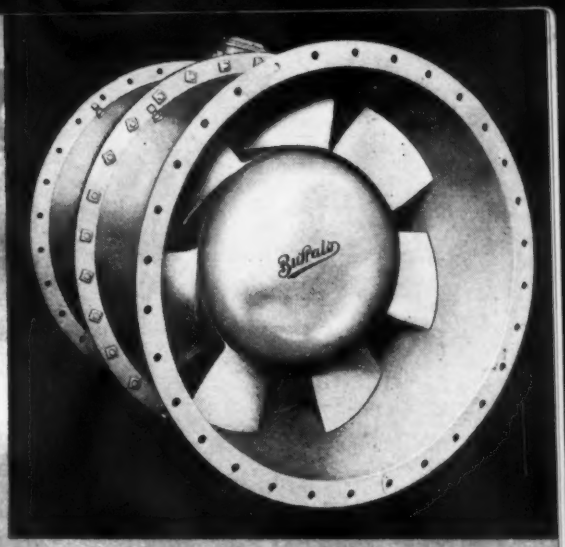
488 BROADWAY **BUFFALO, NEW YORK**

Branch Engineering Offices in Principal Cities

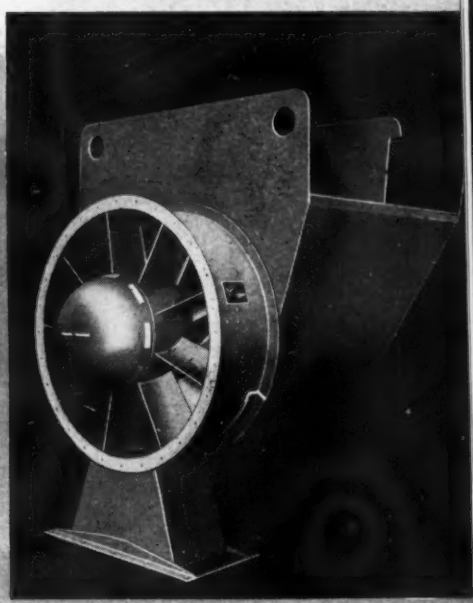
CANADIAN BLOWER & FORGE COMPANY, LTD., KITCHENER, ONT.

"Buffalo" **AXIAL FLOW**

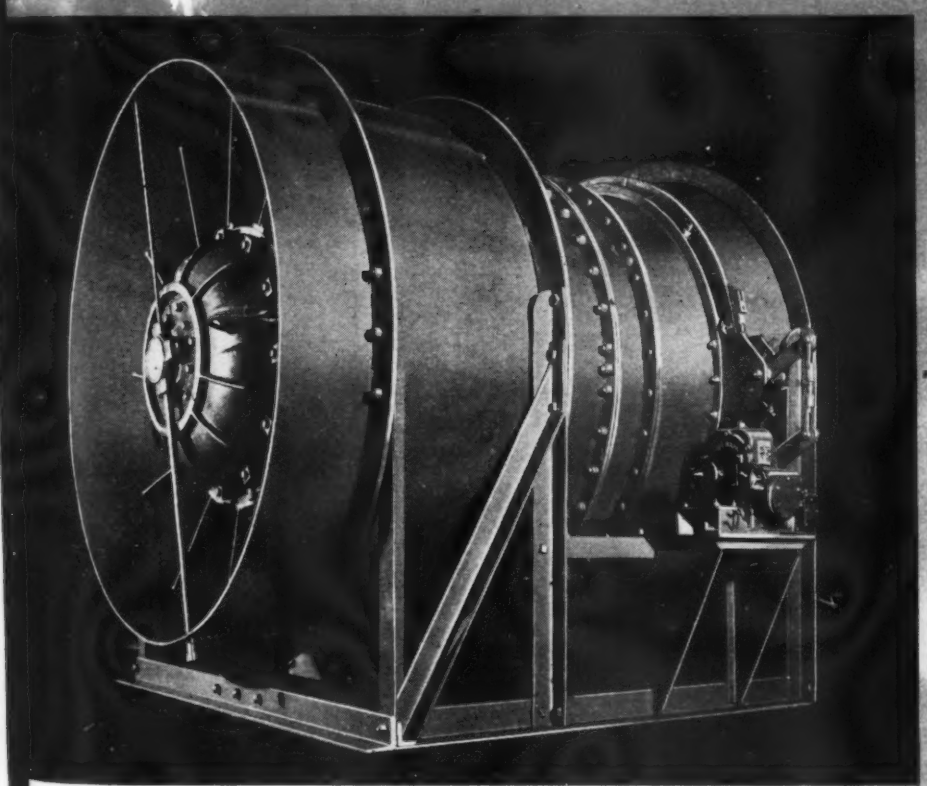
History



"BUFFALO" MARINE TYPE
AXIAL FLOW FAN



"BUFFALO" AXIAL FLOW FAN
FOR MOBILE POWER PLANT



"BUFFALO" AXIAL FLOW FAN USED FOR
AIRPLANE ENGINE TESTING

"BUFFALO" "V"-BELT DRIVEN
INDUSTRIAL AXIAL FLOW FAN

FANS

Pump Quiz:

Q: What is the most commonly made mistake in packing stuffing boxes?

A: Forcing in a ring or two of new packing against the old packing, instead of replacing the old completely. Packing should be replaced periodically, using the type recommended by your pump manufacturer.

Q: What do you do if no water is delivered?

A: First, check these possible causes: 1) Lack of prime. 2) Speed too low. 3) Discharge head too high. 4) Suction lift too high. 5) Impeller completely plugged. 6) Wrong direction of rotation. Then, for list of cures, see page 21 of "Handbook for Wartime Care of Centrifugal Pumps".

Q: How tight should a gland be drawn?

A: To control liquid flow, it should be drawn just tight enough so that a thin stream of liquid flows from the stuffing box during pump operation.

Q: Which goes into position first on installation...the pump or the piping?

A: All piping should be in place and self-supporting *before* connection. Openings should meet with no force. Otherwise casing to apt to crack... or spring enough to allow closely fitted pump parts to rub.

Q: How do you determine whether there are air leaks in the stuffing box?

A: Check to see if thin stream of water flows from stuffing box while pump operates. If not — and adjusting gland to reasonable extent does not produce flow — new packing is probably needed. Or — water seal piping may be plugged... lantern ring may be displaced. Pages 21, 22 and 23 of "Handbook for Wartime Care of Centrifugal Pumps" contain tables showing "causes" and "cures" for most common pump ailments.

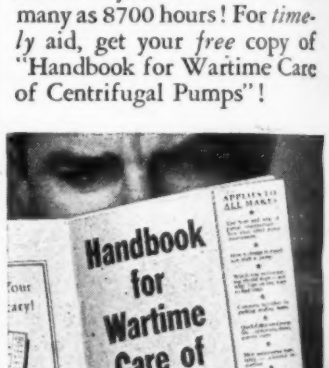
When you do need new pumps — look into the extra efficiency and long life built into Allis-Chalmers centrifugal pumps... all types for every purpose. Meanwhile, every executive, engineer and maintenance man should have a copy of "Handbook for Wartime Care of Centrifugal Pumps" to help make present pumps *last!*

ALLIS-CHALMERS
MILWAUKEE

WE WORK FOR VICTORY — WE PLAN FOR PEACE

DO ALL YOUR MEN KNOW THE ANSWERS TO THESE AND OTHER MAINTENANCE QUESTIONS? IF YOU NOW HAVE A "GREEN HELP" PROBLEM, GET THIS NEW BOOK!

MOST BOOKS on pump care published before the war are *obsolete* today! Why? Pumps that used to work 1800 hours a year now work as many as 8700 hours! For *timely* aid, get your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps"!



Contents include valuable tables of friction losses, a guide to locating trouble, a maintenance timetable geared to wartime! Get *your* copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

Gentlemen:
Yes, I would like to receive, *free of charge*, a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

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"Ankoray" PACKING FABRICATED FROM "Rayon Fiber"

THE ANCHOR PACKING CO. TRADE A MARK

War gives us many new and better products. The new "Ankoray" square braided packings are finding wide application on hydraulic equipment working against oil or water, on high or low pressures.

"Ankoray" packings are made from strong, continuous filaments of duPont's "RAYON No. 126" . . . are low in abrasion . . . stronger and softer than rawhide. Fabricated in sizes ¼" to 1¼", they are furnished on reels or in coil or ring form. When ordering specify "Ankoray" No. 332-T (Tallow Lubricated). "Ankoray" No. 332-WPH (Waterproof Hydraulic). Write for additional information.

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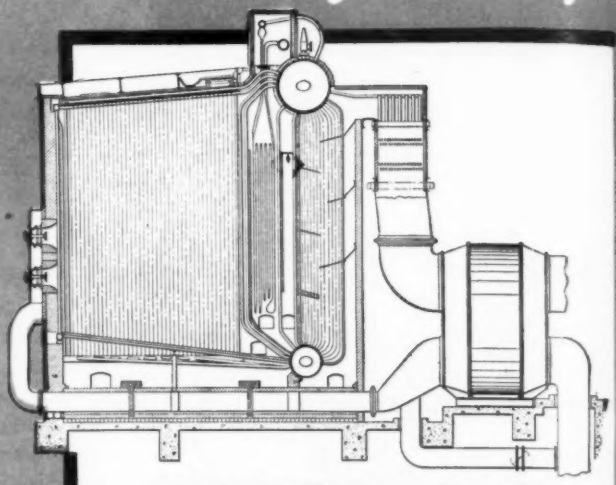
COMBUSTION ENGINEERING'S VU AND

are suitable for any

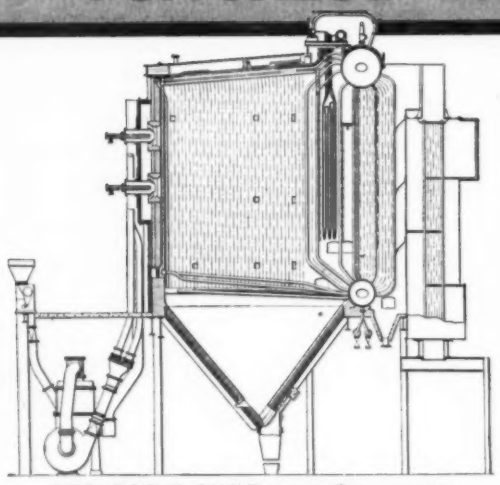
CAPACITIES
from 15,000
to 300,000
lb of steam per hr



300,000 lb VU Steam Generator oil-fired

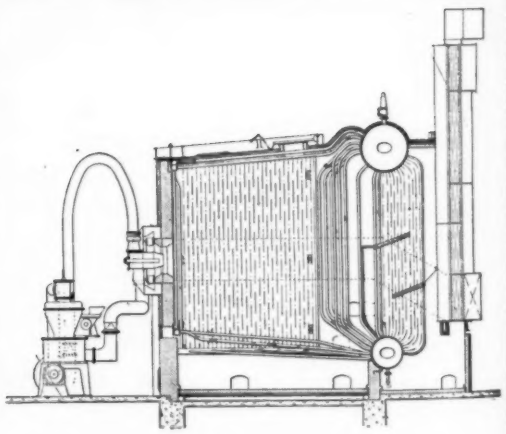
A semi-outdoor installation for a large southern public utility. Includes an Elesco Interbank Superheater and an Elesco Fin Tube Economizer. Design pressure—1000 psi. Total steam temp.—905 F.

Pulverized Coal, Oil, Gas Firing



150,000 lb VU Steam Generator pulverized coal or natural gas-fired

Installation of a mid-west transportation company. Includes Elesco Superheater and Tubular Air Heater. Firing equipment consists of C-E Raymond Bowl Mills and C-E Type R Burners. Design pressure—475 psi. Total steam temp.—735 F.



60,000 lb VU Steam Generator pulverized coal or oil-fired

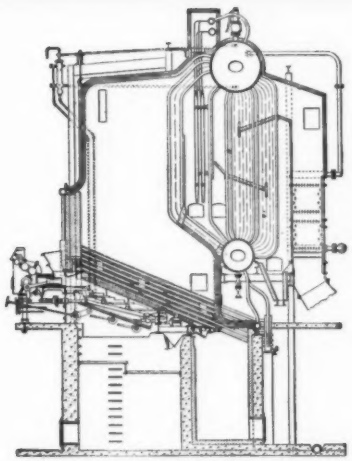
Installation of a southern textile mill. Firing equipment consists of C-E Raymond Bowl Mill and C-E Type R Burner. Design pressure—300 psi. No superheat.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

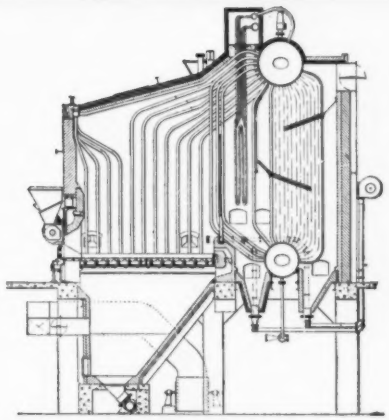
VU-Z STEAM GENERATORS

fuel or method of firing



70,000 lb VU-Z Steam Generator with C-E Multiple Retort Stoker

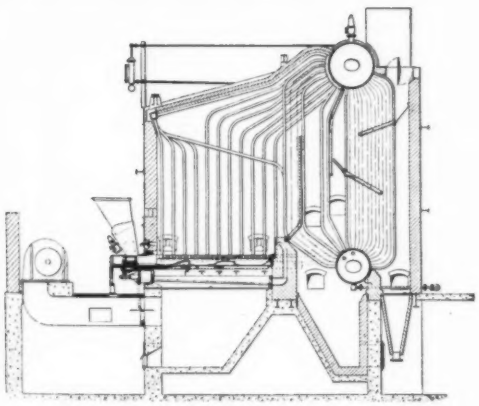
Installation of a large southern utility. Includes Elesco Interbank Superheater and Elesco Fin Tube Economizer. Design press.—250 psi. Total steam temp.—510 F.



38,800 lb VU-Z Steam Generator with C-E Spreader Stoker

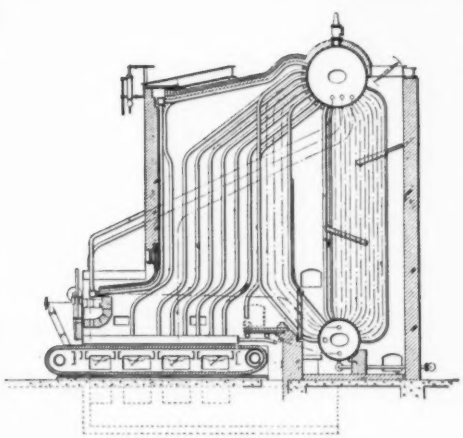
One of three VU-Z Units installed by a mid-west cement plant. Included are Elesco Interbank Superheaters. All three are fired by C-E Spreader Stokers. Design pressure—275 psi. Total steam temp.—468 F.

Various Types of Stoker Firing



35,000 lb VU-Z Steam Generator with C-E Type E Stoker

Installation of an eastern oil equipment manufacturer. Design pressure—200 psi. No superheat.



35,000 lb VU-Z Steam Generator with C-E Chain Grate Stoker

Installation for a mid-west confectionery plant. Design pressure—200 psi. No superheat.

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING

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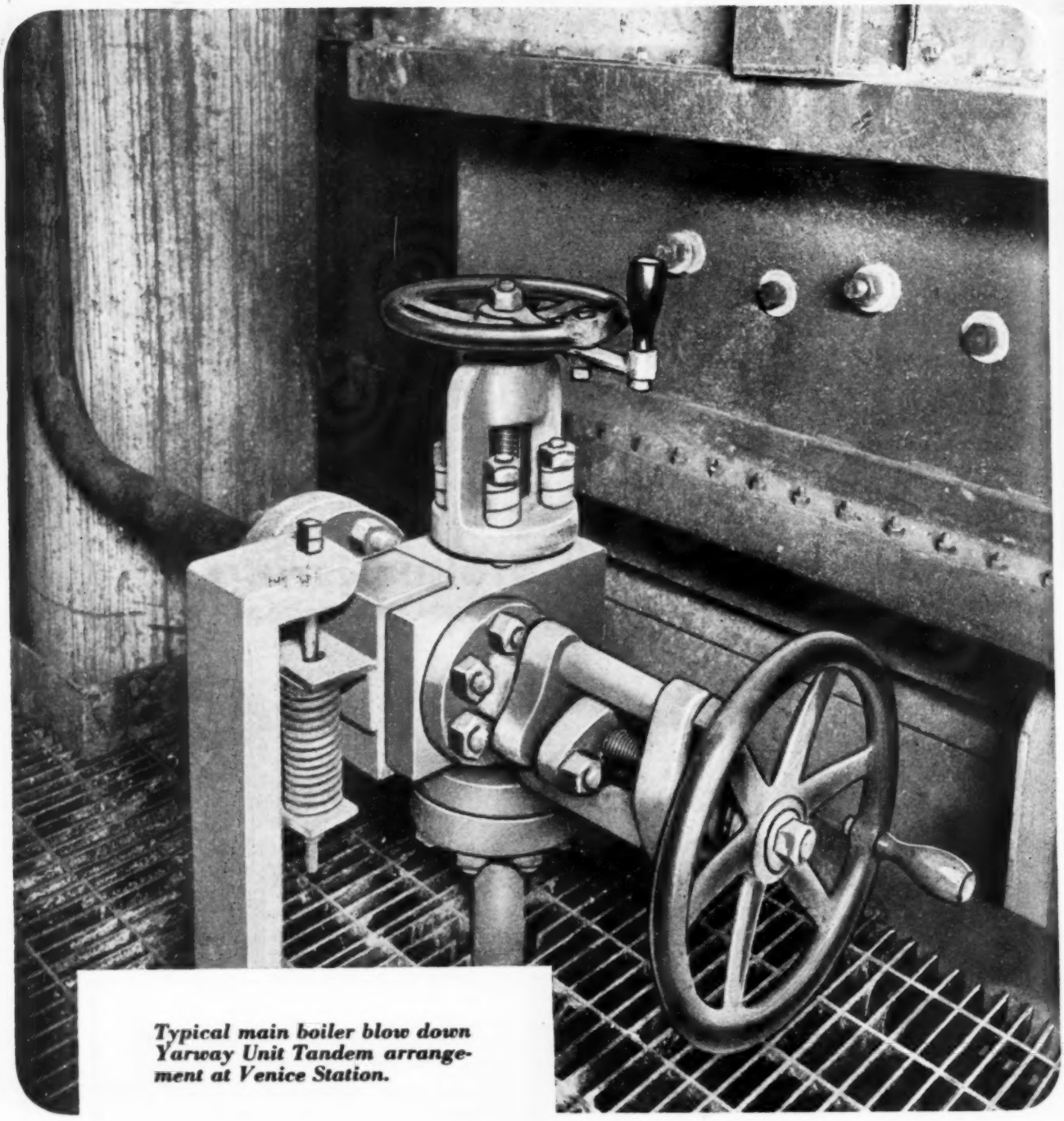
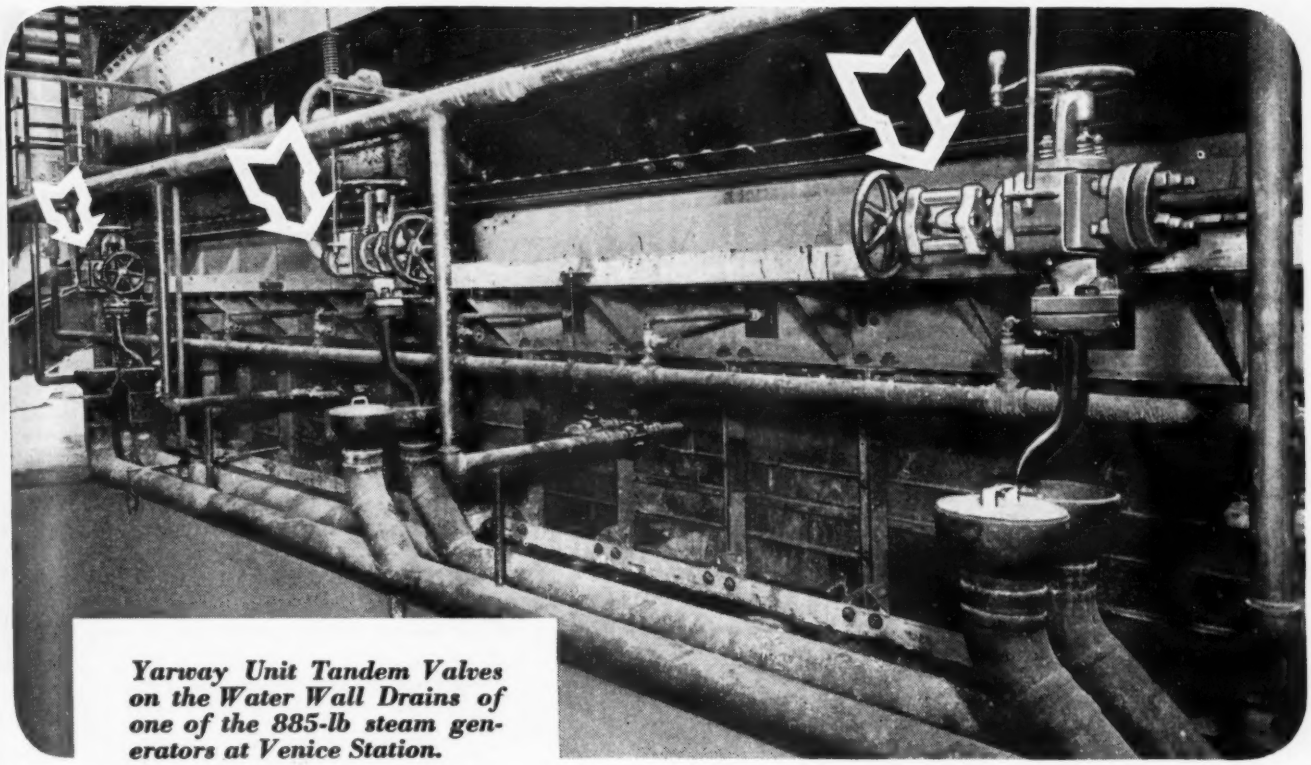
16 YARWAY UNIT TANDEMS..



Typical main boiler blow down Yarway Unit Tandem arrangement at Venice Station.

YARWAY

Selected for Both Blowing and Draining on latest VENICE STATION units



Yarway Unit Tandem Valves on the Water Wall Drains of one of the 885-lb steam generators at Venice Station.

AT the new Venice, Illinois, Station of the Union Electric Company, Yarway Unit Tandem Blow-Off Valves were selected for both main boiler blow-down lines and water wall drains on these latest 885-lb pressure units.

Years of experience with Yarway Valves at the Cahokia Station of this company where 240 Yarway Seatless Valves have been on the job—some as long as 14 years—undoubtedly played a big part in influencing the selection of these Unit Tandems—the finest Yarway Valves ever built for high pressure service—for this modern central station.

What are your drain or blow-down valve requirements? Profit from the sound design and metallurgy of Yarway Valves, proved in more than 12,000 low, medium and high pressure Yarway installations.

Write for Catalog B-422 for pressures up to 400 lb; B-431 for pressures up to 2500 lb.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Phila. 18, Pa.

BLOW-OFF VALVES

SAVE BOILER

Republic

ELECTRUNITE

REG. U. S. PAT. OFF.

INSTALLATION REPAIR OUTAGE TIME

Down goes a boiler for re-tubing — and immediately your production is handicapped. You need that boiler — its full capacity — to keep war output up where it's needed.

The big problem is to get it back into operation just as soon as possible — and that's where Republic ELECTRUNITE Tubes are proving of inestimable help to boiler users today.

These tubes are shortening installation time both on new and re-tubing jobs.

They are *CONSISTENTLY* uniform in diameter, wall thickness, concentricity and ductility. Hence, they slide in easily —roller expand smoothly and quickly— weld freely. Tight joints usually are obtained on first rolling. Seldom is it necessary to re-roll a "weeper". *There are no hard spots to cause rolling difficulty.*

ELECTRUNITE Tubes also save repair time and outage time in another way. Their smooth surface, free both inside and outside from corrosion-inviting scale and scale pits, helps to extend tube life and thus lengthen the time between re-tubings.

Continuous production is vitally important today — but so too are costs. When you save installation, repair and outage time, you cut costs. For more than ten years, ELECTRUNITE users have been reporting up to 30% saving in installation costs alone.

ELECTRUNITE Tubes are produced to meet all standard specifications, including U. S. Navy and Federal Specifications. Would you like to know more about these easy-to-install, long-lasting tubes? We'll gladly send literature.

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REPUBLIC STEEL PRODUCTION FOR VICTORY

BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Simplicity of Design Means Easier Maintenance

It fits perfectly . . .

One body takes either the rising stem or non-rising stem trim assembly. A timely feature when it's necessary to convert from one type to the other. Simply loosen the trim assembly and lift out. The body remains in the line.

Double Wedge Disc
Rising Stem

Single Wedge Disc
Non-rising Stem

125 lb. S.P. BRONZE GATE VALVES

espond to Good Treatment . . .
Take Care of Those You Have

Nowadays when the valves you have must do double duty it is just good business to do a little extra checking of this vital equipment.

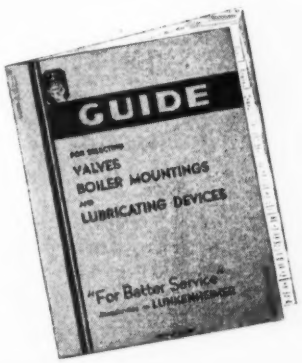
Even the best valves need looking after, and prompt servicing when necessary will save more costly repairs and replacements later.

Lunkenheimer Valves are easy to keep in good operating condition. Simplicity of design, with few working parts, makes them readily accessible for inspection and maintenance follow up.

Again we say, take care of the valves you have. They'll respond to good treatment and repay you in better service, less time out for repairs, and a minimum expenditure for maintenance.

The complete facilities of Lunkenheimer distributors are at your service. They'll help you get what you need and there's one near you to serve you.

Ask for Lunkenheimer Catalog 78 and the Guide for selecting Valves, Boiler Mountings and Lubricating Devices.



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BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

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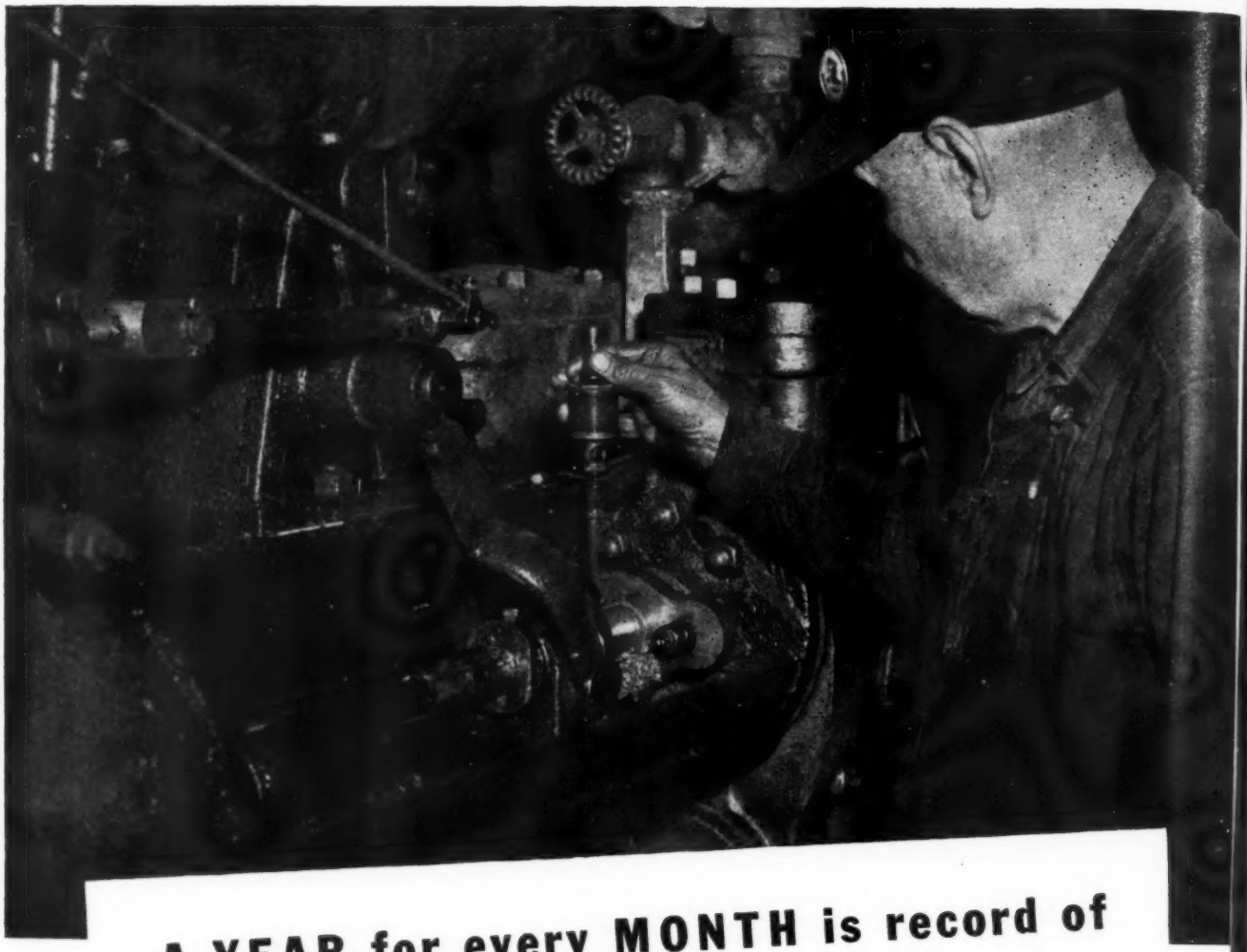


A YEAR for every MONTH is record of MONEL replacing bronze pump rods

In 1930, the Lima Locomotive Works, Inc., Lima, Ohio, replaced worn bronze rods in three boiler feed pumps with Monel.

The bronze rods, used on pumps that supply water to seven boilers, had lasted only 10 to 12 months. The water is extremely corrosive, being high in sulphur content, and the rods are exposed to soot, coal dust and sand.

Today, more than 12 years later, the Monel rods are still at work . . . giving a year, and more, of service for every month given by the bronze!

The Monel rods are mirror smooth, with only slight longitudinal grooves. In twelve years of steady service . . . as long as three weeks at a time without a moment's stop . . . they have worn down less than 1/16" in diameter. They are expected to last at least another year before replacement.

In the words of W. N. McConkey, Shop Engineer at the Lima Works, "When we put in the Monel rods, we expected them to save us some of the rod troubles we used to have with those pumps. We hoped they would last three or four years . . . but we never expected that they would last more than 12 years."

Monel, installed by foresighted management long before the war, is providing extra, trouble-free service today, when replacements are so difficult to obtain.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK 5, N.Y.

★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

Belting and Hose with a Thumb

The thumb gives man his mastery over animals—his control of physical activity. The thumb symbolizes power and capability; strength put to work.

We say "Belting and hose with a thumb" because this statement best expresses the extra something that distinguishes Thermoid belting, hose and other industrial products. The engineers who design these products, and the production specialists who build them, have a realistic viewpoint that takes end-use problems into consideration. Beyond the belting and the hose, they see the tasks to be performed in the transmission of power and the movement of material.

This approach results in products that establish outstanding performance records . . . products that are born with the extra serviceability symbolized by the thumb. When "Thermoid" is on the products, everyone from the President down knows that the Purchasing Agent is buying the very best that can be had.

P.S. In line with material conservation, Thermoid has prepared a series of bulletins on how to extend the life of rubber products now in use. You might find them helpful to be passed on as reminders to your operating people. Feel free to ask for copies.

THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products.

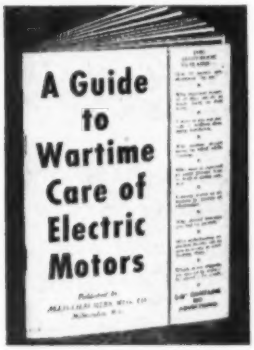
Thermoid Rubber
DIVISION OF THERMOID CO.
TRENTON, NEW JERSEY

IT'S GOOD BUSINESS TO DO BUSINESS WITH THERMOID

FIRST AID FOR MOTORS

MOTORS RUN A FEVER? No wonder if they do more often today. They're working *3 and 4 times* as many hours as in peace!

Wartime conditions demand you diagnose motor ailments *quickly* . . . remedy the trouble at once. At right are but few of the many diagnoses found in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors". In maintenance as in war, *attack is the best defense.* This book singles out the 9 main enemies of electric motors . . . tells you how to get them *before* they get your motors!



Over 100,000 copies already in use.

Write today for your *free* copy. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

SYMPTOMS YOU CAN SEE

Symptom	Possible Causes	Cure
1. Excessive sparking or flashing at brushes. Blackened commutator.	Rough commutator.	Sand or turn down, depending upon depth of surface roughness.
	Low bar on commutator.	Grind or turn down balance of commutator.
	High bar on commutator.	If extreme, lower with mallet, tightening clamping ring. Grind true.
	Brushes too short.	Replace with harder grade—if worn too soon . . . and not by rough commutator.
	Shorted armature winding.	Test for short—after removing metallic contact between commutator bars. Repair.
2. Intermittent sparking at brushes.	Open armature winding.	Locate and replace bad coil—or repair defective joint.
3. Motor won't start.	Usually line trouble.	Correct. Check source of power supply.
	Load too heavy. See if motor runs without load.	Reduce load—or replace motor with unit of greater capacity.

SYMPTOMS YOU CAN HEAR

4. Excessive hum.	Uneven air gap. Measure with feelers.	Replace bearings—before introduction of scraping noise indicates rotor is rubbing.
	Unbalanced rotor. Check on parallel bars.	Balance with solder on band—or weight attached by cap screw and lock washer.
5. Regular clicking.	Matter in air gap.	Take out rotor; remove matter.
6. Rapid knocking	Misalignment.	Realign set until knocking disappears.
7. Brush "chatter."	Extreme vibration.	See item 10, below.

SYMPTOMS YOU CAN FEEL

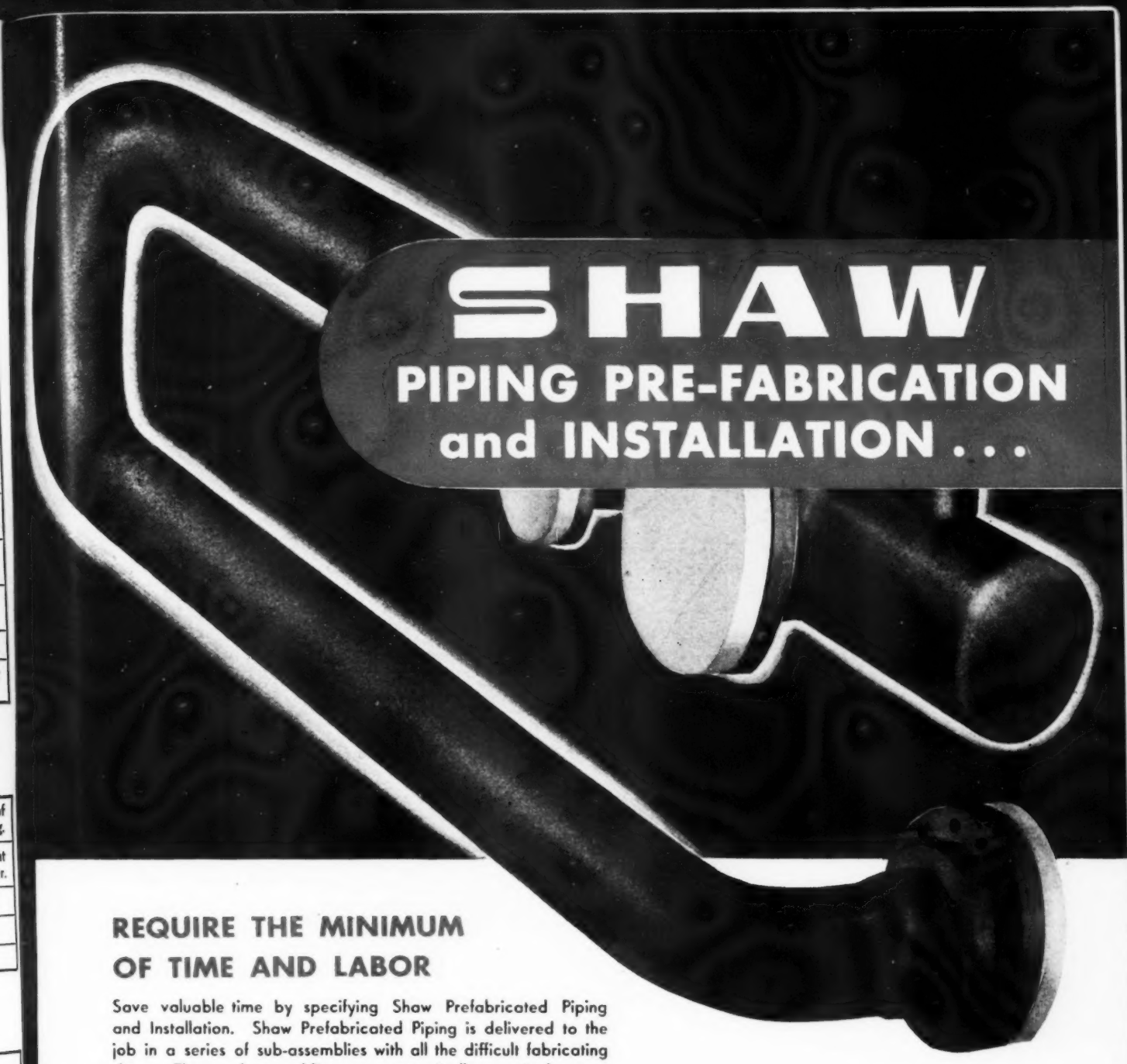
8. Vibration.	Misalignment.	Realign set.
	Vibration in driven machine.	Eliminate source in machine, if possible. Or a flexible belt drive may be in order.
9. Motor overheating. (Check with thermometer — don't depend on hand).	Overload. Measure load; compare with nameplate rating.	Check for excessive friction in motor, drive or machine. Reduce load, or replace motor with greater capacity unit.
	Dirt in motor. Check flow of air.	Blow out motor. Use solvent on wound section if necessary.
	Rotor rubs stator.	Replace bearings.

A 1

ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

AC WE WORK FOR VICTORY WE PLAN FOR PEACE



SHAW
PIPING PRE-FABRICATION and INSTALLATION . . .

REQUIRE THE MINIMUM OF TIME AND LABOR

Save valuable time by specifying Shaw Prefabricated Piping and Installation. Shaw Prefabricated Piping is delivered to the job in a series of sub-assemblies with all the difficult fabricating done. These sub-assemblies are economically practical, stress-relieved, accurately aligned, cleaned and inspected. Installation by our trained workmen reduces your installation costs to a minimum.

In your initial planning, let Shaw help you with your piping requirements. We may be able to make worthwhile suggestions that can save you time and money—improve your prefabricated piping installation.

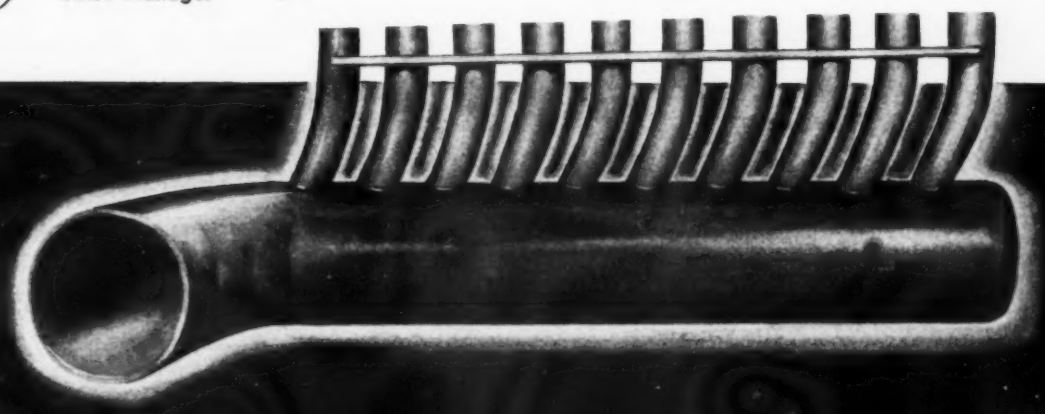
J. Frederick Merz
Sales Manager

50th Anniversary Year

BENJAMIN F. SHAW CO.

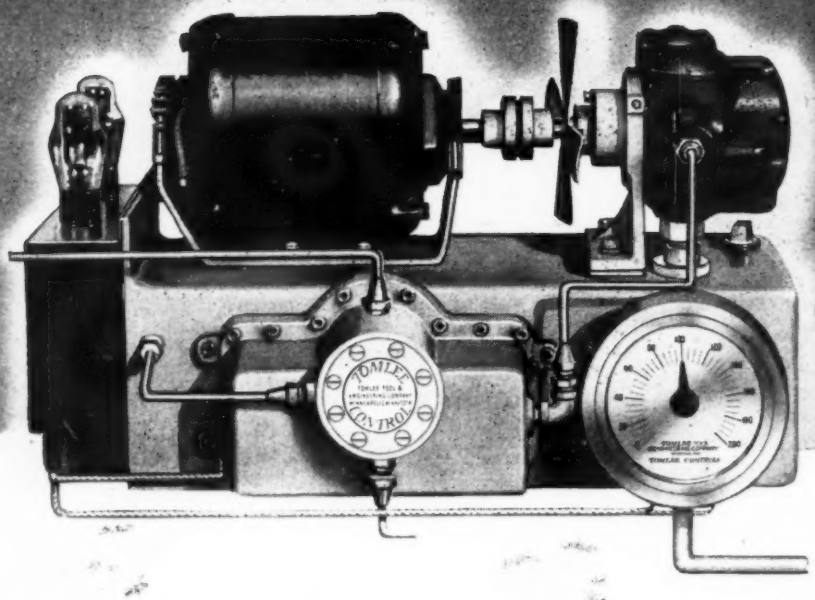
2nd & Lombard Streets

WILMINGTON 99, DELAWARE

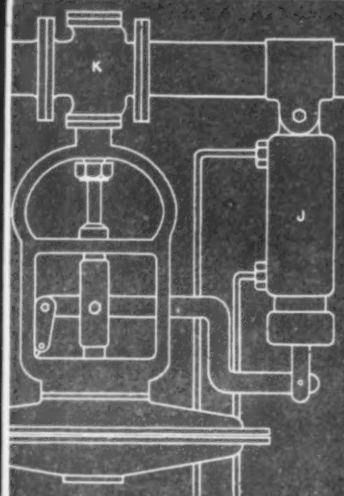


ANNOUNCING

. . . An Electronically Operated Control System That Regulates Time • Temperature • Quantity • Pressure • Flow • And Other Factors With Infinite Precision



The Tomlee Electronic Control System is compact. It measures only 22" x 15" x 20" and weighs only 50 lbs.



Its Operation

As slight variations in pressure occur at impulse tube (A), they are transmitted to the extremely sensitive element (B). These slight variations in pressure open or close a contact in (B) which operates on only 2 milliamperes of current. This feeble current operates tubes (C) and (D) in Flashtron Unit (E). Tubes (C) and (D) cause either one of two solenoids located in housing (F) to operate four-way valve (G), which turns a maximum of 11 degrees in either a clockwise or counter-clockwise direction, forcing oil under heavy pressure through hydraulic lines (H) and (I). This hydraulic pressure operates a piston in hydraulic unit (J) which in turn modulates reducing valve (K) in fractions of a thousandth of an inch, thereby causing the valve to literally float on a cushion of live, high-pressure steam, constantly responsive to the minutest variations in impulse tube (A), and maintaining the value pre-set by adjusting of control unit (B). It can be readily understood that this constant correction of infinitesimal variations in pressure in line (L) is bound to result in material savings in steam and consequent fuel costs as well as maintaining an unvarying pressure so important in process work. Tank (M) is an oil reservoir. Motor (N) operates Webster Electric Pump (P), which maintains permanent high pressure in four-way valve (G) and hydraulic lines (H) and (I).

WE HAVE ALL HEARD a lot about Electronic Control but very little about its practical application to specific requirements.

Here—in the Tomlee Electronic Control System—you now have a complete electronically operated control system that can be fitted to practically any control need.

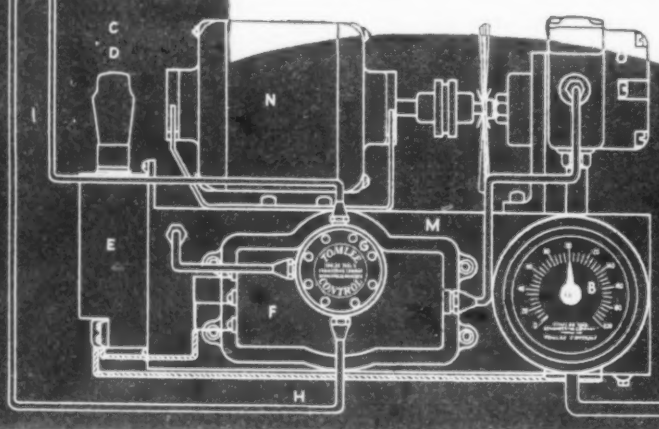
The Tomlee Electronic Control System is a comparatively simple, one-piece, compact unit, precision-built by an aggressive young company that is skilled in working to tolerances as fine as .000005".

The system is a combination of electronic, electrical, hydraulic and mechanical operations and is so sensitive that it will record and correct minute variations in any pre-set value in milliseconds, thereby eliminating "lag" and preventing the accumulation of repeated errors that affect quality of product, cause waste of time and increase costs.

The theory incorporated in the Tomlee Electronic Control System design is neither new, untried nor unproved. Nearly ten years of commercial tests and actual operation lie behind its successful and profitable use. This can be verified.

The schematic diagram of its application to reducing valve control is shown and briefly described here. Study this, interpreting the operation in terms of the control problems facing you. Then write us regarding them.

Informative literature covering its design, construction, operation and application, now in preparation, will be sent you upon request. TOMLEE TOOL & ENGINEERING COMPANY, 253 Third Avenue South, Minneapolis (15), Minnesota.



TOMLEE
ELECTRONIC
CONTROL
SYSTEM

THE award of the coveted ARMY-NAVY "E" for outstanding production is recognition of our efforts in the design and manufacture of oil filtration equipment for internal combustion engines.

We are fully conscious of the responsibility which the "E" places upon us to reach new goals in production, and to continue intensive research in this vital field of engine and oil maintenance for the war effort.

BRIGGS CLARIFIER COMPANY

WASHINGTON, D. C.

Designers and manufacturers of filtration equipment.

COPYRIGHT 1943 — JONES & LAUGHLIN STEEL CORPORATION

FROM AN ORIGINAL DRAWING BY ORISON MACPHERSON

STRONG STEEL—THE METAL BY WHICH OTHER METALS FLY AND FIGHT

Gouged, hammered, pried from its mold of sand and gagger-bars, this mammoth one-piece casting of war-steel emerges in a form of massive strength to do a job on the production front as no other material could do it. A product of the art and skill of J&L foundrymen, this casting, a hydraulic cylinder, is the heart of power for a gigantic extrusion press. Strong steel in this and other castings, weighing up to 280,000 pounds, enables the giant mechanical presses to exert pressures so great as to squeeze aluminum, copper, brass and other metals, as well as certain steels, through small die openings like a pastry cook extrudes cake-icing through the tip of a pastry cone. By this extruding process these other metals are formed into hundreds of parts for aircraft engines, flying instruments and airplane assemblies as well as parts for weapons and other fighting equipment.

Thus steel — strong steel — which is being produced at the rate of 90 million tons a year, is doing two war jobs. First: steel is serving on the invasion fronts in the form of tanks, guns, ships, planes, ammunition and other military supplies, and second: it is serving on the production front in the form of machines, large and powerful, small and intricate, that shape other metals and materials including plastics and certain steels into equipment and arms for victory.

PITTSBURGH WORKS

ALIQUIPPA WORKS

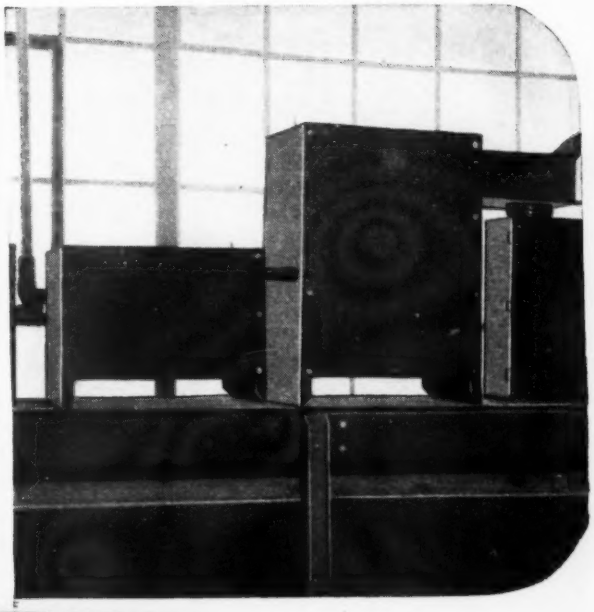
JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH, PENNSYLVANIA

J&L STEEL

CONTROLLED QUALITY STEEL FOR WAR

- ★ **Saved critical material, time, labor, money—by eliminating the need for extensive rewiring.**
- ★ **Reduced the load demand of the plant's electric system more than one third.**
- ★ **Improved voltage regulation throughout the entire plant, and decreased the load on the feeders.**
- ★ **Reduced the power cost**
- ★ **Made possible greater production**



One of the three Pyranol capacitor installations at Gate City Iron Works that made available more power for welding, motors, and plant lighting.

WHAT CAPACITORS DID for the Gate City Iron Works

THEY CAN DO FOR YOU

WHEN the Gate City Iron Works in Omaha, Nebraska, needed additional capacity for greatly increased welding operations, they got it by improving power factor by means of Pyranol capacitors. Three 240-kva units did the job, with the results listed above.

If your plant's power system is fully loaded—or overloaded—and is operating at low power factor, capacitors can help you, too. They supply reactive kva that otherwise has to travel through your transformers and feeders, and thus your plant wiring can carry more working current—as much as 40 per cent in some cases.

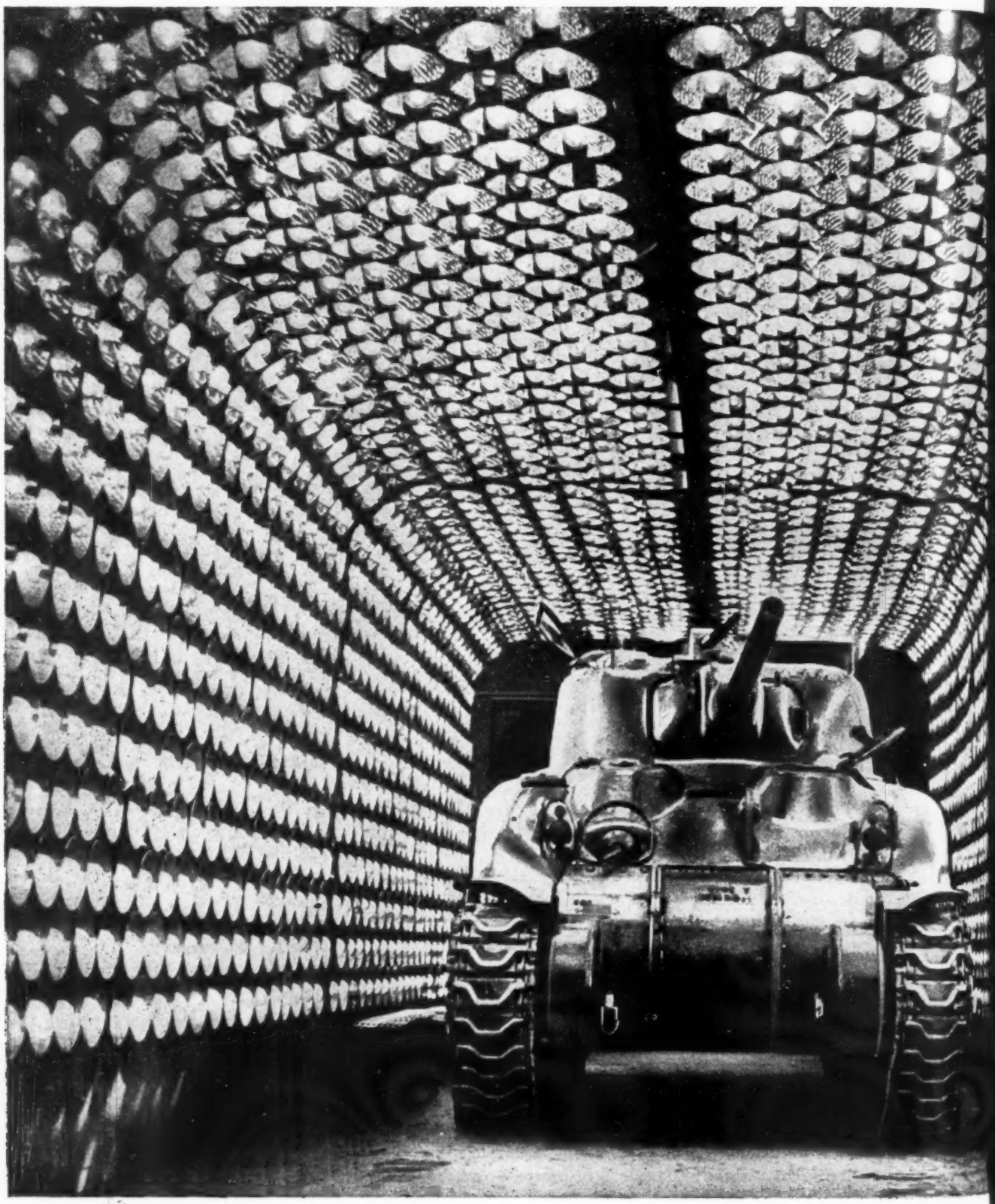
Remember, too, a capacitor installation can be made in a matter of weeks instead of the months necessary with other methods. Ask your G-E representative to estimate the possible increase in your circuit capacity, or write for Bulletin GEA-77. *General Electric Company, Schenectady, N. Y.*

PYRANOL CAPACITORS

The best investment in the world is in this country's future—BUY WAR BONDS

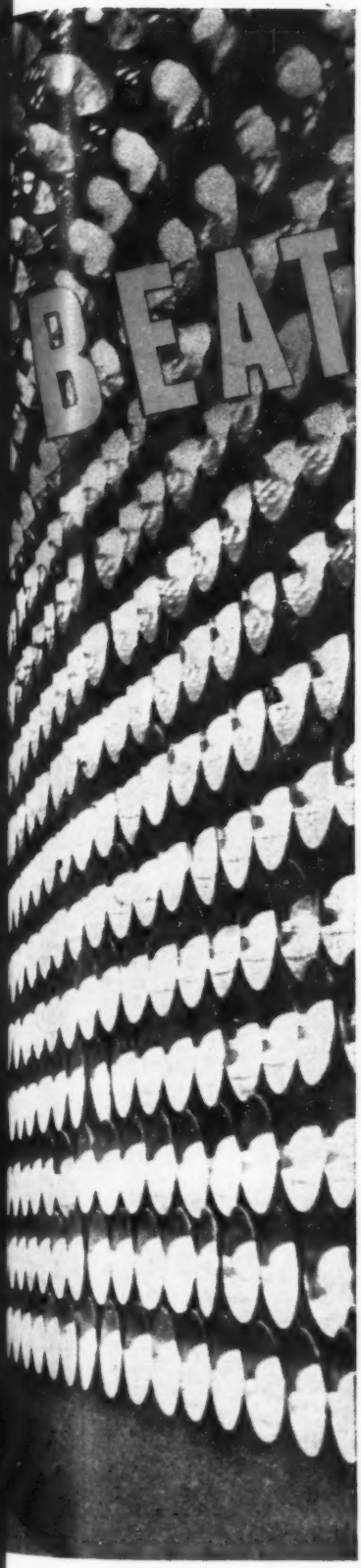
GENERAL ELECTRIC

407-65-5709



TEXACO

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT—CB



BEATING NATURE 1440 to 4

INFRA-RED rays from this tunnel of lamps complete an ordinarily 24-hr. paint drying job in 4 minutes . . . so fast that drivers of freshly-painted tanks stay at the controls. This new method of quick-drying is a vitally important war-time use of electric light and power.

Furnishing America's ever-increasing needs for electric light and power requires peak output from turbo-generating equipment . . . and power plants everywhere are getting maximum efficiency from their steam turbines, by lubricating them with *Texaco Regal Oils*.

Texaco Regal Oils assure normal bearing temperatures, governors instantly responsive to every load change. They keep turbine lubrication systems clean, rapidly free themselves from air and water, highly resist emulsification, gum formation, sludging. *They are rust and oxidation inhibited.*

So effective have Texaco lubricants proved that they are definitely preferred in the various fields listed below.

A Texaco Lubrication Engineer will gladly cooperate in the selection of the most suitable lubricants for your equipment. Just phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

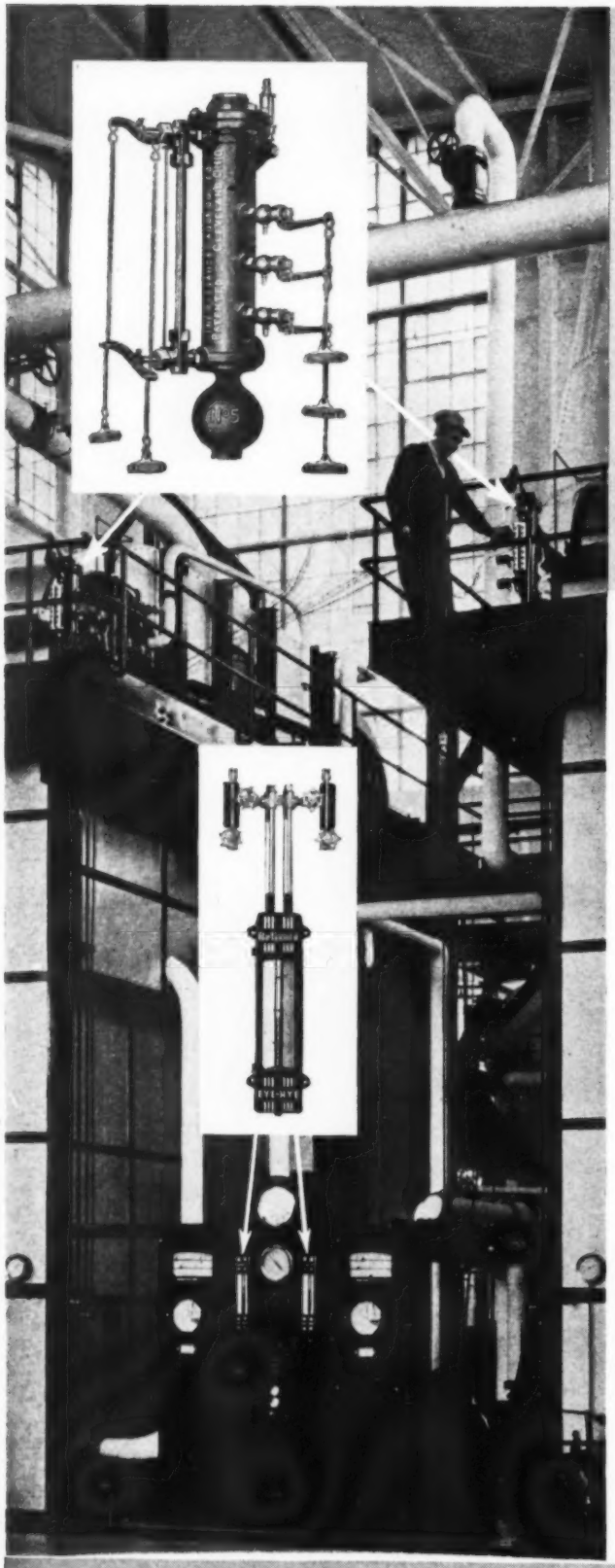
★ More buses, more bus lines and more bus-miles are lubricated and fueled with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

REGAL OILS

FOR ALL TURBINES

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



Common

helps you preve

You minimize boiler outage risks by watching "small" equipment that keeps "big" equipment at work

Reliance Alarm Water Columns

Known in power plants everywhere, Reliance Alarms and Safety Water Gage Equipment are rendering staunch service . . . in war plants and central stations. . . .

Reliance EYE-HYE Remote-Reading Water Level Gage

Thousands of EYE-HYEs save steps for busy power plant men . . . make safe water level supervision doubly sure by bringing gages down to eye-level.

Since 1884

Reliance

Sense Protection

boiler water level accidents

LITTLE POINTERS THAT HELP SHOW THE WAY

ALARM VALVE has hardened stainless steel seat and cone valve to resist abuse from steam flow. Keep the ports clean by blowing whistle at least once each day. Dirt caught between seat and cone valve will cause wire drawing, and eventual leakage.

WHISTLE tone is normally shrill to be heard above boiler room noise. To obtain this effect bell must be centered over bowl with about a three-sixteenth inch clearance. Loosen acorn nut at top to adjust.

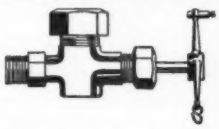
FLOAT is ruggedly built of stainless metal. Denting of lower float may be prevented by opening column blowdown valve slowly to avoid sudden rush of water.

CAP GASKET Corrugated metal is recommended for tight flange joint. Use a new gasket each time column is opened, as cheap insurance against leakage.

GAGE COCK has stainless renewable seat and cone valve. Keep the seat clean by blowdown at least once each day. *Blow thoroughly* to remove all dirt, and maintenance seldom will be required.

***REMEMBER*—replacement parts are available from stock on MRO priority.**

GAGE VALVE Keep stem and glass end stuffing box tight, to prevent steam leakage and unsightly appearance. Moulded metalastic packing for stem end and rubber composition for tubular glass. Valves must be in perfect vertical alignment for safe glass installation.



EYE-HYE VALVE on blowdown lines must be absolutely tight, which is also true of all other *joints* of the installation if satisfactory operation is to be had. Valves controlling boiler pressure to EYE-HYE should be wide open when EYE-HYE is in service.

EYE-HYE PLUG GASKET Metal covered asbestos makes resilient, easy seal, and can be used more than once. Renew them when crushed from use, as leakage should be avoided.

VIZZENE FLUID is a special compound having specific and important characteristics keyed to your EYE-HYE. It is unobtainable except from factory or authorized representatives. Order by *letter* stamped on EYE-HYE name plate.

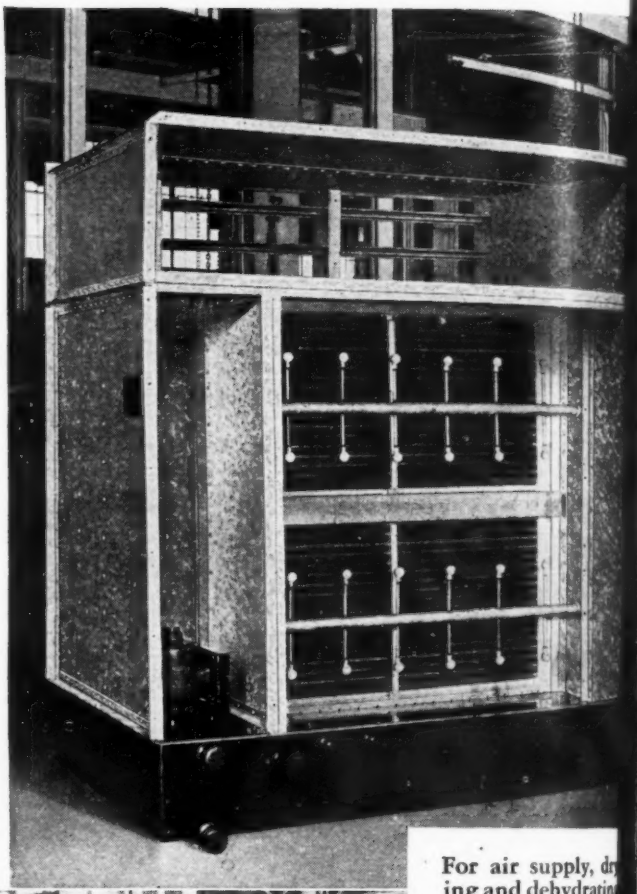
CLEANING FLUID makes the chore of cleaning EYE-HYE simple as A, B, C. Can be used several times over and is handy for other small cleaning jobs where dirt must be removed from the interior of equipment.

BOILER SAFETY DEVICES

THE RELIANCE GAUGE COLUMN CO.
Cleveland, Ohio

Progress and Power in the

Ample, nourishing food is the prime factor in sustaining Civilian morale and industrial efficiency on the home front, and in building the fighting vigor of America's armed forces on land and sea and in the air. In this march to Victory through food, American Blower Fans, Air Washers and Centrifugal Collectors play their part as essential equipment . . . are of special value in the processing of the dehydrated and powdered foods to save cargo space. The Public Utilities, too, which are supplying an ever increasing amount of electric energy to the food industry and to all war industries, are daily finding the true value of American Blower Mechanical Draft equipment, Fluid Drives and Dust Collectors. In war and in peace, American Blower serves America.



For air supply, dr ing and dehydratin American Blowe furnishes the foo candy, meat packin and canning indu tries large quantiti of Fan equipme similar to this.

AMERICAN BLOWER

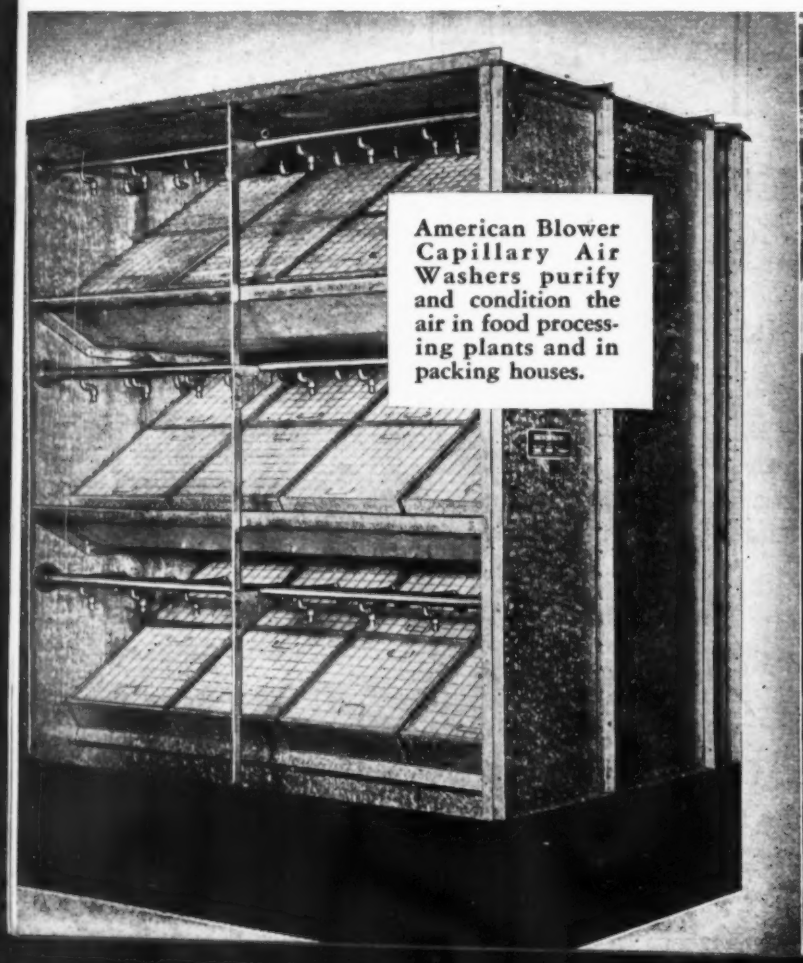
ARMY E NAVY

For Production "Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICH.

CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

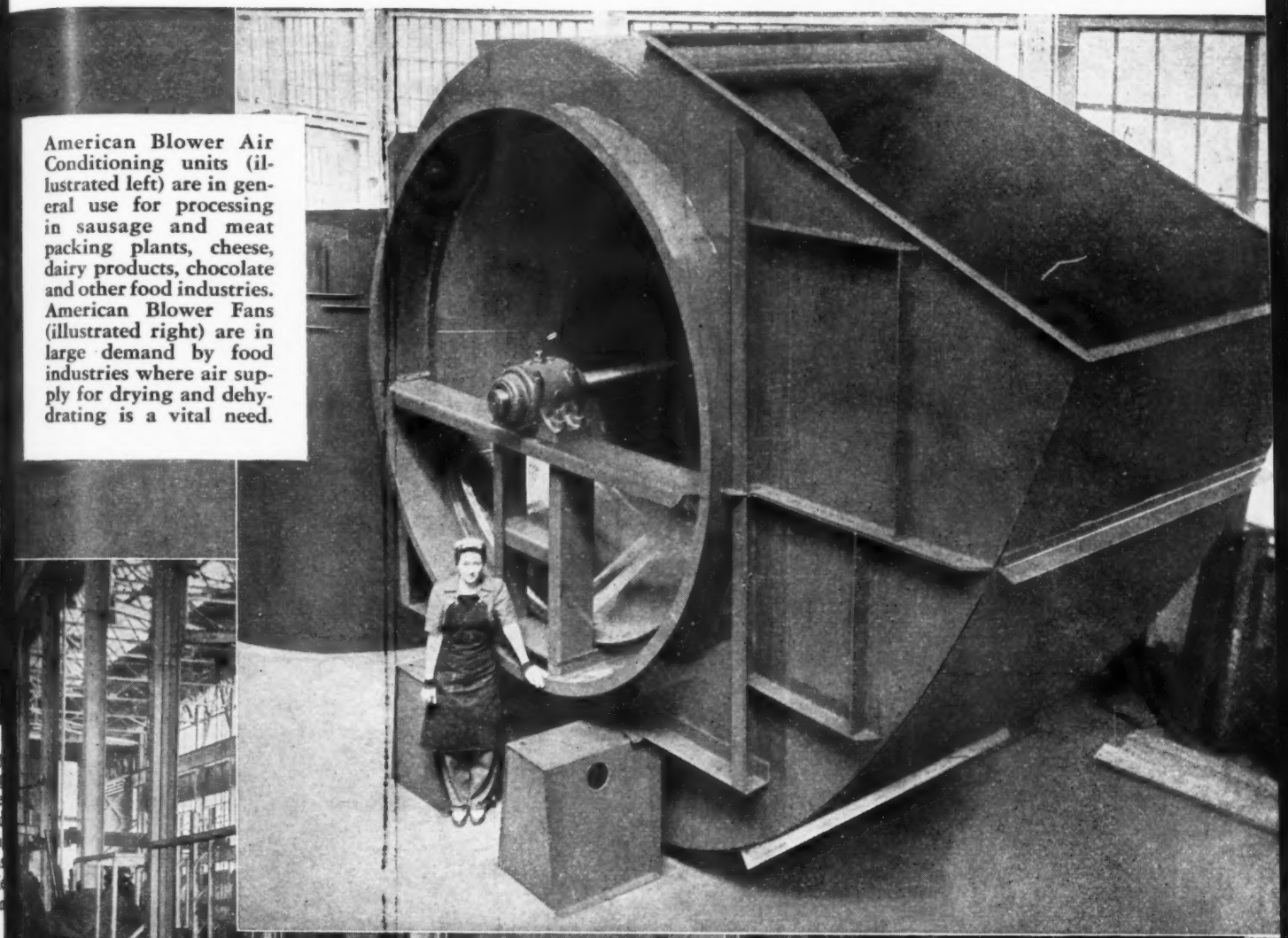
Division of AMERICAN Radiator and Standard Sanitary Corporation

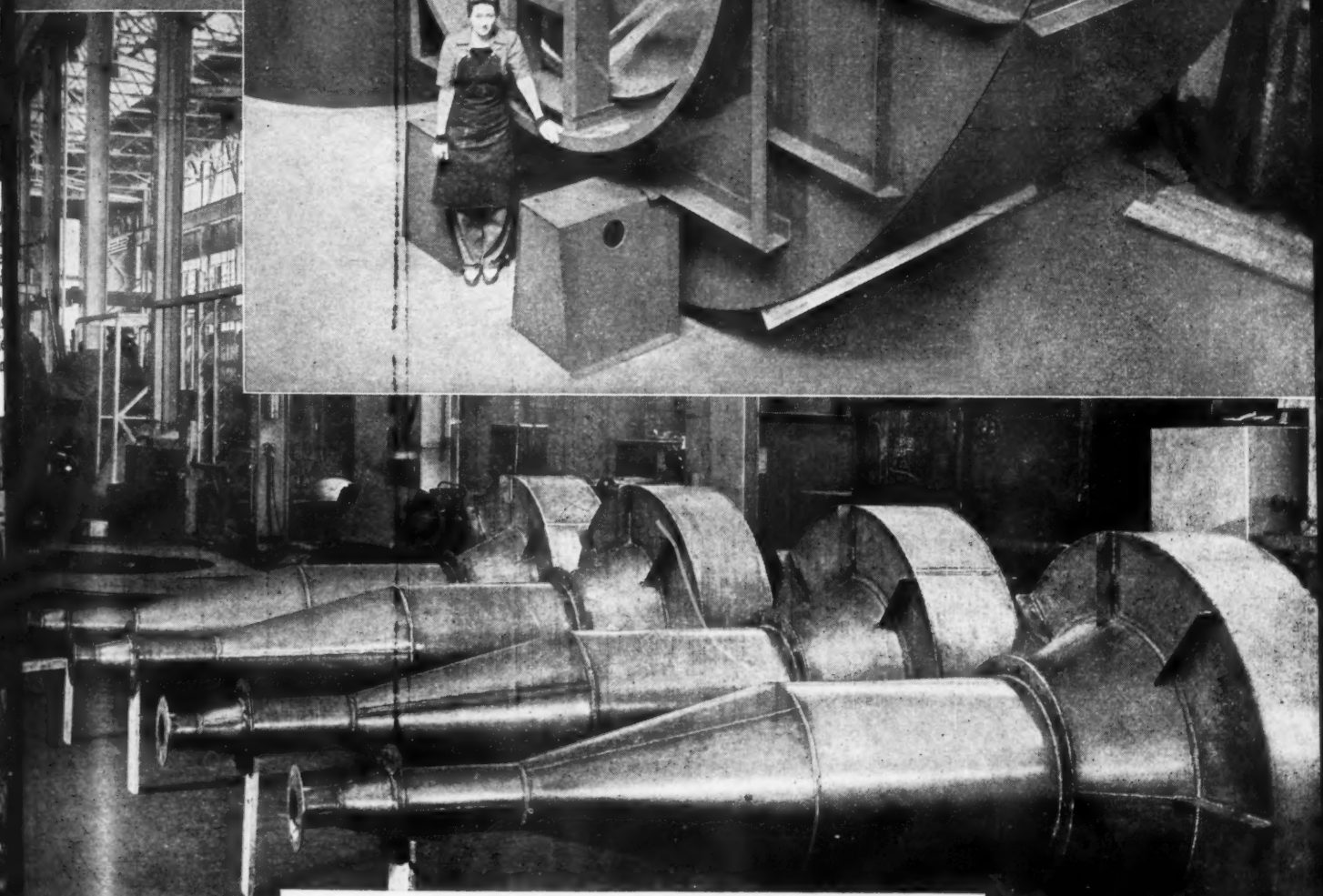


American Blower Capillary Air Washers purify and condition the air in food processing plants and in packing houses.

OOD *and* PACKING INDUSTRIES

American Blower Air Conditioning units (illustrated left) are in general use for processing in sausage and meat packing plants, cheese, dairy products, chocolate and other food industries. American Blower Fans (illustrated right) are in large demand by food industries where air supply for drying and dehydrating is a vital need.





Dehydrated and powdered foods "go farther" . . . require less cargo space . . . are vital to military operations far from home bases. American Blower Centrifugal Collectors as shown here are constructed of stainless steel and are used in many food industries to collect food products during processing.

"...if you'll send us the guns!"

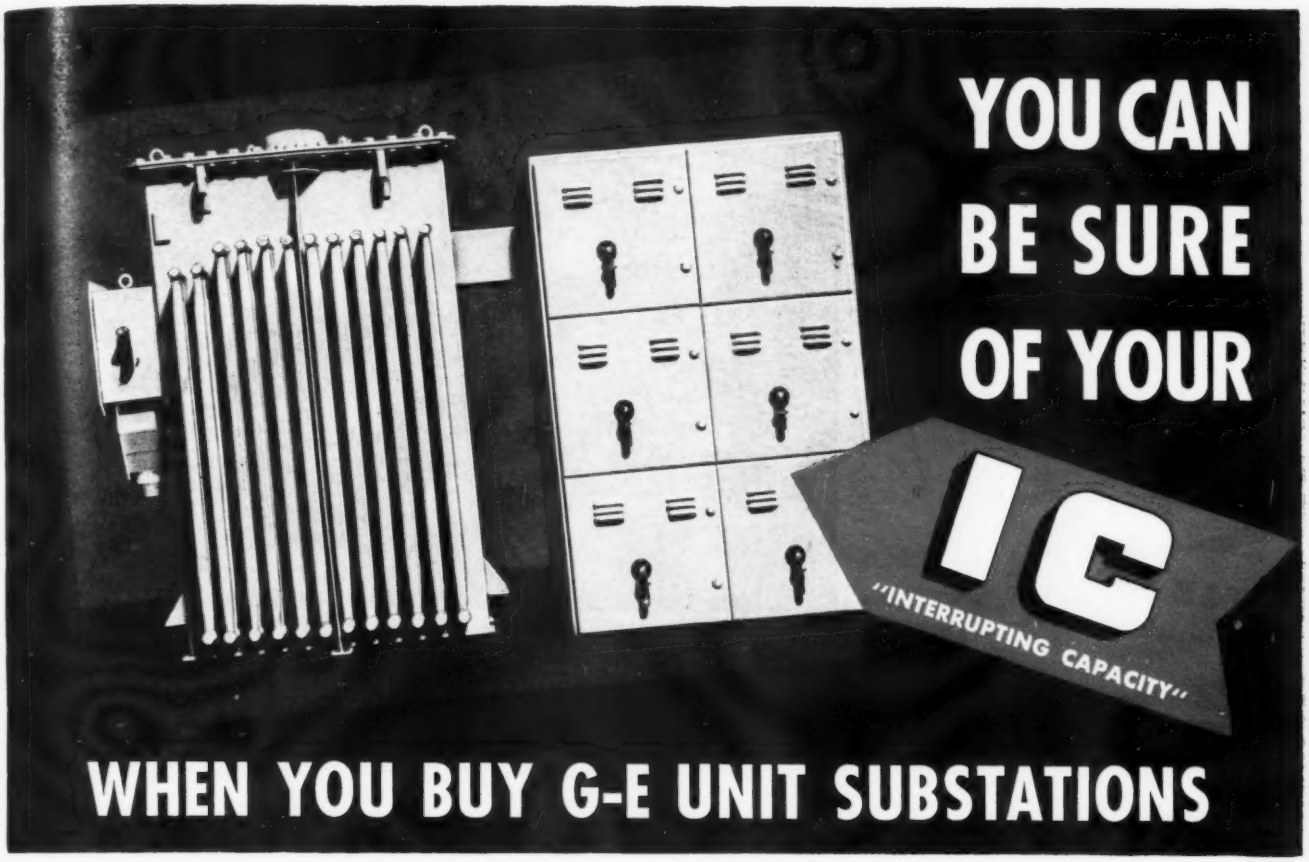
Our boys will gladly risk their lives for Freedom. All they ask of us back home is that we send them the guns, shells and equipment—and send it *fast*. They'll do the rest. So let's keep production zooming along at top-speed. One way to help speed production is to use Garlock Packings, Gaskets and Oil Seals—they give long, dependable service and help you avoid frequent shut-downs.

Garlock

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.



WHEN YOU BUY G-E UNIT SUBSTATIONS

The severity of a short circuit depends largely on the capacity of the substation that feeds the circuit, NOT on the normal load on the circuit. To assure you of *adequate* interrupting capacity for even the most severe short circuits, G-E load-center unit substations are built with *properly rated* breakers. These are air circuit breakers which have been co-ordinated—electrically, mechanically, and thermally—with the capacity of the substation and the system.

G-E drawout air circuit breakers are properly rated—can be inspected quickly and safely—and need little maintenance throughout a long life.

FOR DEPENDABLE PERFORMANCE—

G-E air circuit breakers have positive-acting, dual-magnetic, overcurrent trips which provide time-delay protection for overloads (adjustable from 100 to 200 per cent of the breaker rating), and instantaneous protection from short circuits. Silver-to-silver contacts, fast-acting arc quenchers, and generous current-carrying elements assure reliable operation.

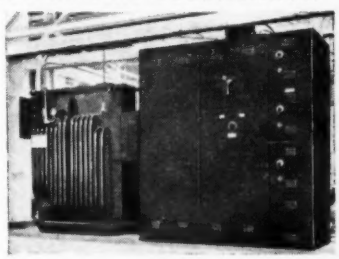
—AND EASY MAINTENANCE

Drawout air circuit breakers, which roll in and out as easily as a file-cabinet drawer, can be inspected, tested, or replaced with another breaker quickly and safely. After a power interruption, a simple turn of the breaker handle quickly restores service. Air circuit breakers in your G-E unit substation assure an important saving in time and labor required for routine inspection and maintenance.

If you need dependable load-center unit substations in a hurry, or simply want more complete information, get in touch with the nearest G-E office, or write to General Electric, Schenectady, N. Y.

FOR D-C, TOO—

RECTIFIER UNIT SUBSTATIONS



Now you can have direct-current power at your load centers by running high-voltage a-c all the way, and converting to d-c with rectifier unit substations located at those centers.

GENERAL ELECTRIC

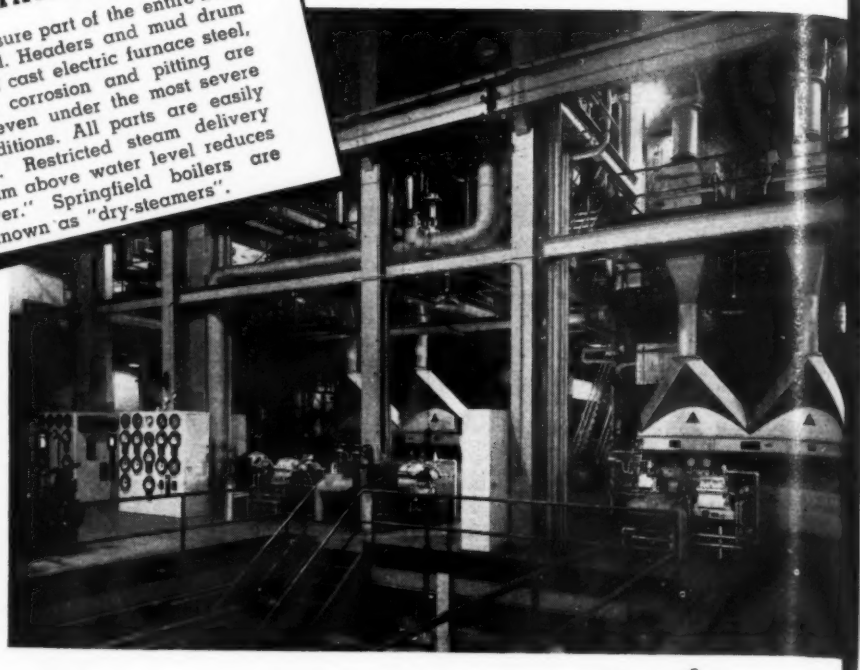
302-18-5900

SAVE SPACE

The Springfield Sectional Header, Horizontal Cross Drum Boiler is lighter in weight and more compact than other designs. Springfield units are readily adapted to suit restricted space requirements.

SAVE MAINTENANCE

Every pressure part of the entire boiler is of steel. Headers and mud drum are made of cast electric furnace steel, with which corrosion and pitting are minimized even under the most severe water conditions. All parts are easily accessible. Restricted steam delivery to the drum above water level reduces "carry-over." Springfield boilers are widely known as "dry-steamers".



SAVE MATERIAL

Worthwhile savings in structural steel, foundations, masonry work, as well as boiler steel, are effected by Springfield Boilers. Tubes are smaller and therefore lighter than in most boilers. Each handhole plate covers four tubes, which means two-thirds less handholes. Only one drum is used.

SAVE STEAM COSTS

The Springfield exclusive staggered tube arrangement, in four-tube groupings . . . the use of 3" tubes . . . sectional baffles of permanent construction . . . these and other Springfield features are reflected in lower exit gas temperatures—i.e. lower steam costs.

SAVE ENGINEERING

Complete drawings, patterns, etc. are on hand to produce duplicate units of many of the great number of modern Springfield generating units built in recent years. Springfield boiler design permits faster fabrication and faster erection.

SAVE TIME

With Springfield Boilers 30 to 60 days may be saved on erection time because of sectional design. Tubes are rolled in the sections and tested before shipment. All parts may be passed through small openings. Only a few boiler tubes need be expanded during erection. Sections may be erected in advance of the drum.

SAVE MONEY

Savings in boiler steel, foundations, masonry work, erection and shipment time, and the economy inherent in the design of the boilers, make Springfield steam generating units among the lowest in boiler cost per thousand pounds of steam.

Can you match these Boiler Savings?

CAPACITIES of Springfield boilers range from 5,000 to 450,000 lbs. per hour, or more. Pressures from 75 to 750 lbs. or higher. Springfield also makes high capacity water walls, to secure higher capacity with existing boilers, and to provide the maximum in overload capacity with new installations. Contracts taken for complete steam generating units. Write for information. SPRINGFIELD BOILER COMPANY, 1951 E. Capitol Ave., Springfield, Illinois.

Some Springfield Boiler Users .

South Pittsburgh Water Co., Pittsburgh, Pa.—4 plants.
Inland Steel Co., Indiana Harbor, Ind.—6 boilers.
Anaconda Copper Min. Co., Cananea, Sonora, Mex.
State of Illinois (over 40 units in State institutions)
Hell Gate Station, United Elec. Lt. & Power, N. Y. C.
East River Station, New York Edison Co., N. Y. C.
Sherman Creek Station, New York Edison Co., N.Y.C.
Iowa Elec. Lt. & Pow. Co., Cedar Rapids & Boone, Ia.
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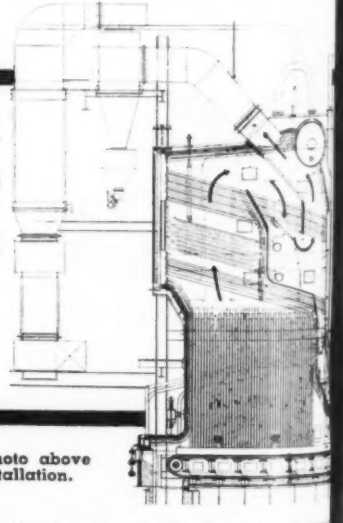
hundreds of others, in the U. S. and abroad.



Boiler diagram at right and photo above show University of Illinois installation.

SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

My Grandfather used to say—

My grandfather was a funny old guy—a sort of heating adviser whose main business was pipe and fittings, and the miscellaneous hardware items sold over the counter in the old days.

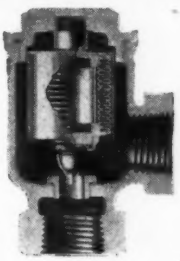
He used to carry a few steam traps, too, but the range was limited. They were all of one kind, and he used to sell them by the pipe size just like a nipple or a globe valve. Capacity meant nothing to him.

So, of course, his steam trap business never flourished. It was nothing but a continuous headache, and I often heard him say that he would never carry any more of the darned things.

Are you too thinking of steam traps as an unavoidable nuisance? If so, it may be that you have the wrong *kind* of trap for the particular job.

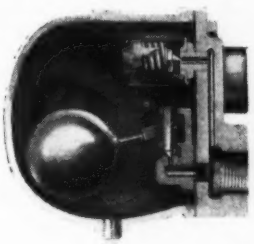
There are many good steam traps, but there is no universal trap. Sarco makes the four distinct types illustrated, each one a leader in the field and guaranteed to increase efficiency and give long, trouble-free service.

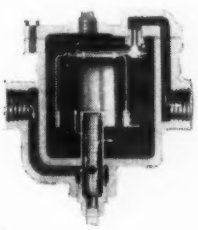
For correct selection of the most efficient type for any application, consult us or our nearest representative.



No. 9

FLOAT-THERMOSTATIC





BUCKET

No. 87

SARCO Saves Steam

Represented in Principal Cities

SARCO COMPANY, INC., 475 FIFTH AVENUE, NEW YORK 17, N. Y.

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

Pipes are the crossroads of industrial power. We make anything in tubular or plate steel fabrication: Fabricated Piping—for steam, water, air, oil, gas chemicals • Random mill or cut lengths, bent, coiled, welded, flanged, threaded • Valves, Pipe Fittings.

If you have not received our new 64-page

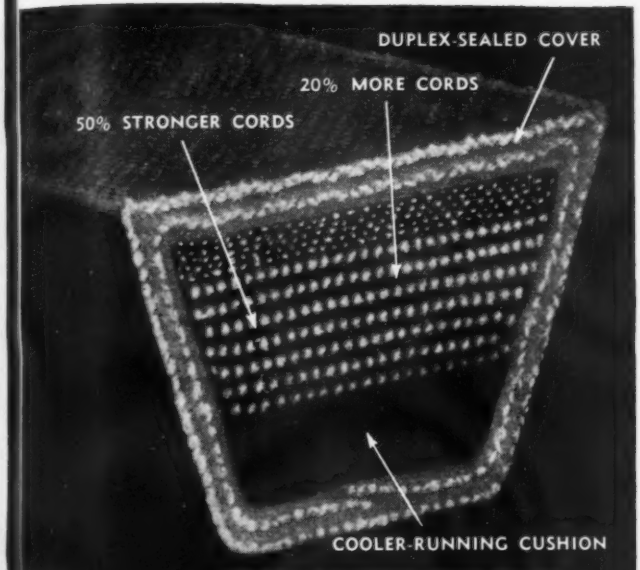
FLORI GUIDE of FABRICATED PIPING

send us your name and address. We shall be glad to mail it to you without charge.

FLORI PIPING

THE FLORI PIPE COMPANY • ST. LOUIS—CHICAGO

HOW TO Give V-Belt Wear the new "One-Two"!



1 BUY THE BEST BELTS...

You're 'way ahead of maintenance worries when you get the new Texrope Super-7, with revolutionary design-against-wear. 20% *more* cords — special-treated by the new Flexon process to make them 50% *stronger* — fight stretch. A cool-running rubber cushion "floats" cords around sheaves. Duplex-Sealed cover guards belt against grit, grime, moisture. When you *do* need new V-belts *invest in the best* — Texrope Super-7!

2 USE THE BEST CARE...

Want to make your present belts last *longer?* You can, no matter what brand you're using. Allis-Chalmers' new handbook: "Plain Facts on Wartime Care of Rubber V-Belts", gives you the "know-how" with tips on *what determines V-belt life expectancy... good rule-of-thumb for tension* ...and a lot more. It's jam-packed with valuable data — ideal for training new men. Tear off the coupon below and send for your *free* copy... today.

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TEXROPE* SUPER-7 V-BELTS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

*Trade mark registered U. S. Patent Office. Texrope Super-7 V-Belts are the result of the cooperative research and design genius of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by Allis-Chalmers. Available in all sizes.

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive free of charge a copy of your "Plain Facts on Wartime Care of V-Belts".

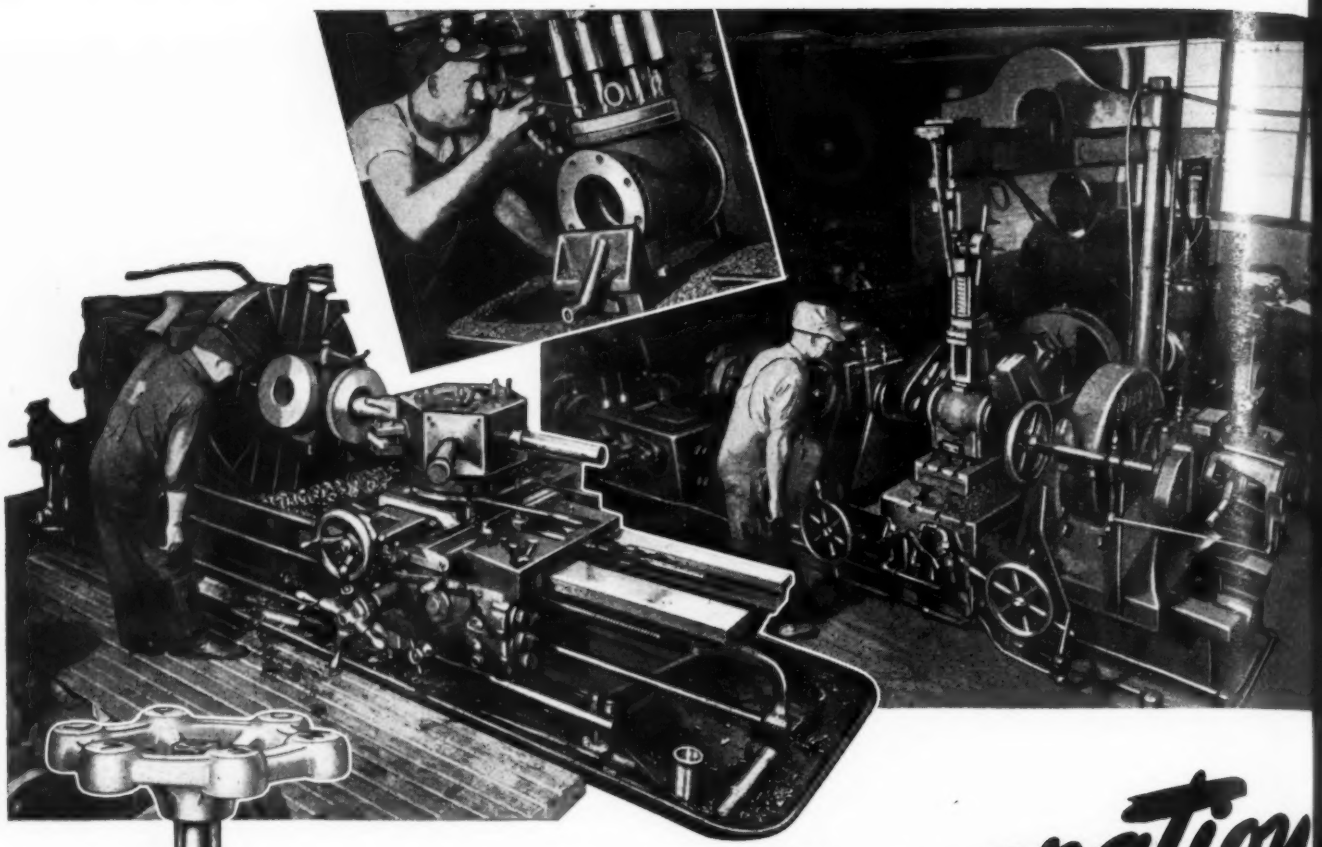
(Name)

(Title)

(Company)

(Street Address)

(City and State) A 1643-4



Final Preparation

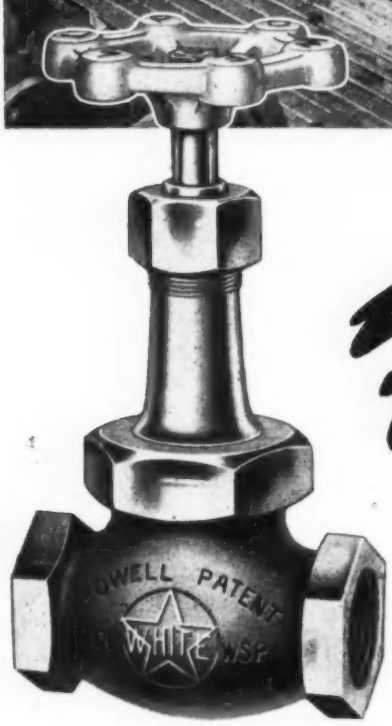


Fig. 1708 —Bronze Globe Valve, with screwed ends, union bonnet, renewable seat and regrindable, renewable hard bronze semi-cone plug-type disc. Can be repacked under pressure when wide open. Sizes, ¼" to 3", inclusive, for 200 pounds W. P.

With the skill born of long experience, POWELL craftsmen "finish" the product that will honor the family motto—"Standard for Control." These valves started their career from the point of an engineer's pencil—part of the process of POWELL's creative cooperation with technical and maintenance staffs. In every process of manufacture these valves have been tested to POWELL's pre-determined requirements for material, function, longevity . . . to the letter of the law of POWELL's specialized manufacture of valves and nothing but valves.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati, Ohio

POWELL

Fig. 386—200-pound Bronze Gate Valve with screwed ends, outside screw rising stem, screwed in yoke bonnet, bolted flanged packing gland, and renewable hard bronze seat rings and taper wedge solid disc. Sizes ½" to 3", inclusive.

...for a long, useful life!

Fig. 500—125-pound Bronze Gate Valve with screwed ends and screwed-in bonnet. Sizes ¼" to ¾" equipped with taper wedge solid disc; sizes 1" to 3" with taper wedge double disc.

Fig. 375—200-pound Bronze Gate Valve with screwed ends, union bonnet, inside screw rising stem and special hard bronze disc. Sizes ¼" to 3", inclusive.

VALVES

Save HEATING

Hotter Iron

ARMSTRONG UNIT TRAPPING SPEEDS UP BED SPREAD IRONING RATE 150% IN MAYO HOTEL LAUNDRY

ttsburgh Product

Cut Cooking Time 75% For Soybean P

By J. W. HIERON

Canning Plant Speeds Up Cooking Kettles 30%

of increasing efficiency.
stepping up

Save Two Hour Per Day

By E. C. WALDSMI

STEAM CONSUMPTION CUT 47.5%; TEMPER RAISED 70°

HESE steam consumption charts show the results obtained by a plant in New Zealand after they re- steam traps with 8

Steam Consumption Chart
London Imperial Flat W
6 12" Rolls and 1 48" R
1 X Steam Traps Ave
830 lbs. Steam
A
RE

ARMSTRONG INVERTED BUCKET STEAM TRAP

One authority has stated that under extreme conditions, ½ of 1% by volume of air mixed with steam may result in a reduction of heat transfer efficiency as great as 50%.

Standard Armstrong Trap; showing how air is discharged along with the condensate.

Armstrong Blast Trap, with thermic vent, for eliminating large volumes of air.

Think what efficient air and condensate elimination can mean to *your* production!

Armstrong STEAM

TIME...to speed up Production

Flower Comp
39%
40%
FASTER HEATING
Of reports that have been turned in over the past 13 years dealing with faster heating secured by Armstrong trapping, those that give figures show an average speed up of 40%!

rk
e Mo
rapping Speeds Up Six-Roll Ironer 20%
C. PRICE
Laundrym
are

WITH time, fuel, manpower and industrial equipment all at a premium, it is vitally important that no method of speeding up production be overlooked.

Heating time on steam-jacketed equipment, unit heaters, dryer rolls, cookers, evaporators, and other heating and process units, can often be cut a surprising degree by Armstrong Unit Trapping.

Automatic Air Elimination—Air in heating units, dryers and other process equipment dilutes steam, reduces its temperature and impedes heat transfer. Armstrong Traps speed up heating by eliminating air automatically along with the condensate.

Automatic Condensate Drainage—Sluggish condensate elimination slows up heating. Armstrong Traps remove condensate as fast as it accumulates and under all load conditions, without steam loss. Steam saving means fuel saving.

Your Armstrong Representative is a trained trapping specialist; ask him for the Armstrong Steam Trap Book and advice on trapping problems.

ARMSTRONG MACHINE WORKS
812 Maple St. • Three Rivers, Michigan

SILLY, ISN'T IT?—BUT IT'S JUST AS SILLY TO HAVE TRAPS THAT LEAK STEAM OR DON'T WORK PROPERLY.

TRAPS

CAN YOU PUT

Your Finger

ON POTENTIAL TROUBLE SPOTS BEFORE THEY HAMPER PRODUCTION?

EVERY power plant or process is a chain of equipment elements in which some "weak link" may limit the capacity or its failure cause a shut-down of the entire plant. Can you put your finger on these potential trouble spots as they develop, before they get into the emergency class and disrupt production schedules?

Flow meters are bloodhounds for spotting faulty conditions as soon as they occur. An installation of boiler and distribution meters will enable you to track down these potential trouble spots long before they have a chance to become serious. This is of prime importance where the plant load is putting severe demands on both equipment and personnel.

Power engineers in hundreds of industrial plants have found that the data made available by an intelligently engineered metering system has enabled them to increase the *de-*

pendable capacity of their plant by spotting and fixing weak links before they fail—and to increase the *effective capacity* of their plant by eliminating all unnecessary consumption of steam, water, compressed air, etc. Here are a few typical examples:

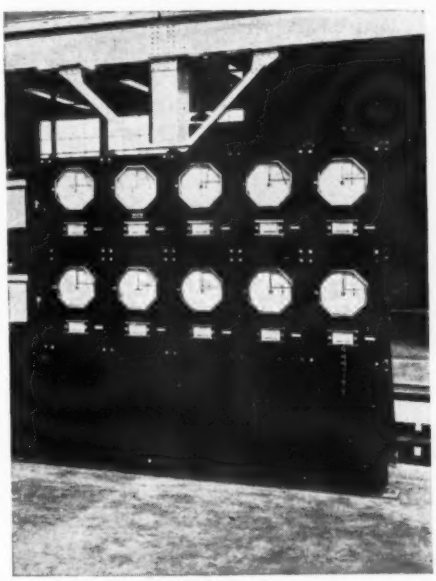
You can't improve conditions until you know what the conditions are.

TURBINE TROUBLES?

About a year after a turbine had been installed, difficulty was experienced in meeting the steam demand at certain times. Since this trouble had never arisen before, faulty operation of the turbine was suspected. Before deciding to overhaul the turbine, an expensive procedure, a Republic flow meter was installed on the turbine steam line. This meter instantly revealed that the turbine was operating within 2% of the performance guarantee and that the real trouble was in the steam generating plant. Here it was found that two of the units were delivering only 60% of their rated output. The data provided by the flow meter prevented an unnecessary turbine overhauling and placed the blame where it belonged.

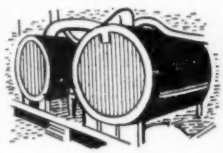
PUMP TROUBLES?

When a battery of six process water pumps failed to operate at full capacity it was necessary to dismantle them one by one to locate the trouble. This procedure required two weeks to find out what an installation of flow meters could have revealed in two seconds. Of course, there was only one answer—Republic meters now measure the discharge from each pump.



EFFECTIVE CAPACITY?

By studying steam and water flow meter records, a process plant found it possible to shut down a triple-effect evaporator completely and draw liquor of the same strength from an intermediate stage of a quadruple-effect evaporator. This change saved approximately 100,000 lb. of steam per day. Thus the effective capacity of the boiler plant was increased by this amount.



Hundreds of similar experiences recorded in our files provide overwhelming evidence of the value of Republic meters.

A COMPLETE METERING SERVICE

The Republic Flow Meters Co. offers nationwide evidence of the preference shown by industrial leaders for Republic flow meters. Whether it be in the steel industry, paper industry, chemical industry or other major industries, you will find an impressive number of Republic flow meters measuring the distribution of steam, water, gas and air.

What does this leadership mean to you? Briefly, this: when you decide—as you eventually will—to take full advantage of the assistance modern instruments can render, a statement of your aims to Republic will make available an unmatched experience, a complete range of instruments and alternative schemes to choose from. One of our engineers will be glad to call at your request, without any obligations on your part.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago, Illinois

More Air to make More Iron to make More Arms

Turbine Driven Blast Furnace Blower on test in De Laval Shops

Three De Laval BLAST FURNACE BLOWERS of the latest design are being built at the De Laval Works; two of which are for a steel company already operating four De Laval blowers having an aggregate inlet capacity of 262,000 cu. ft. per minute against 30 lb. gage maximum pressure.

Each of the new machines is rated at 90,000 cfm. of air, as measured at standard conditions of 60° F. and 30 in. barometer, and to deliver against 30 lb. per sq. in. maximum pressure, with an actual capacity of 97,800 cfm. at normal operating inlet pressure and temperature conditions.

The units are controlled automatically to deliver a constant weight of air.

The design and materials for the driving turbines are suitable for operation with a maximum steam pressure of 700 psig and maximum temperature of 775° F.

3825

De Laval STEAM TURBINE CO.
TRENTON 2, N.J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL; and FLEXIBLE COUPLINGS

OCTOBER 1943

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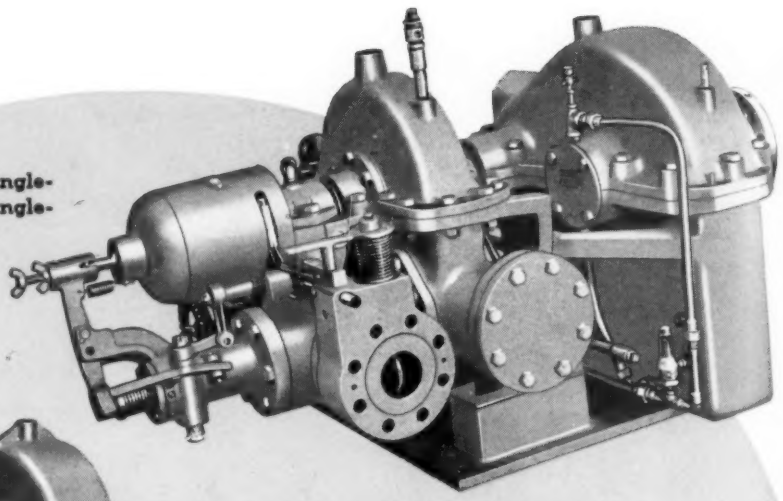
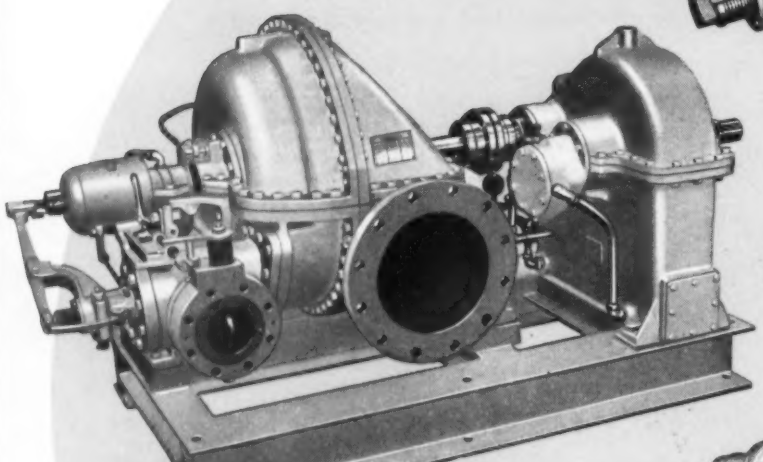
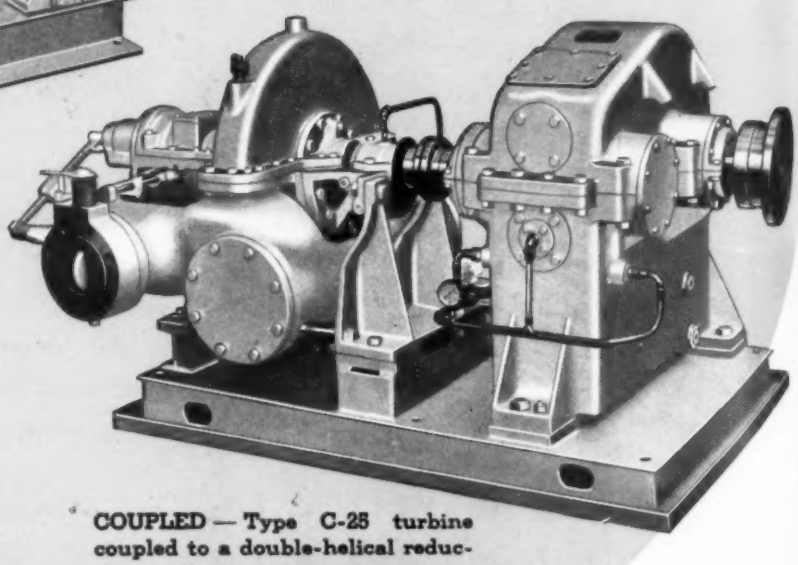
GEARED steam drive



INTEGRAL — Type C-20 single-stage turbine with integral, single-helical reduction gear.



COUPLED—Type C-225 multi-stage turbine, with a coupled, double-helical reduction gear.



Forced feed lubrication for turbine and gear is provided on Westinghouse geared units and includes oil pump driven from gear shaft, external oil cooler and gear base oil reservoir.

COUPLED — Type C-25 turbine coupled to a double-helical reduction unit.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

DESIGNED FOR YOUR SPEED!

STEAM HEADQUARTERS HAS THE GEARS TO MATCH THE TURBINE

INTEGRAL OR COUPLED GEAR RATIOS FROM 2-TO-1 THROUGH 14-TO-1

Where machinery must be driven at speeds lower than economical turbine speeds, Westinghouse can supply the right reduction gear to permit operation of both turbine and driven equipment at favorable speeds. These are not ordinary gears. They are built *specifically* for use with turbines—and each unit falls heir to millions of horsepower of gear experience, both land and marine.

EASY ALIGNMENT. In the Westinghouse design, the entire unit is supported at three points by machined pads. This arrangement prevents distortion of the housing and facilitates alignment with driven apparatus.

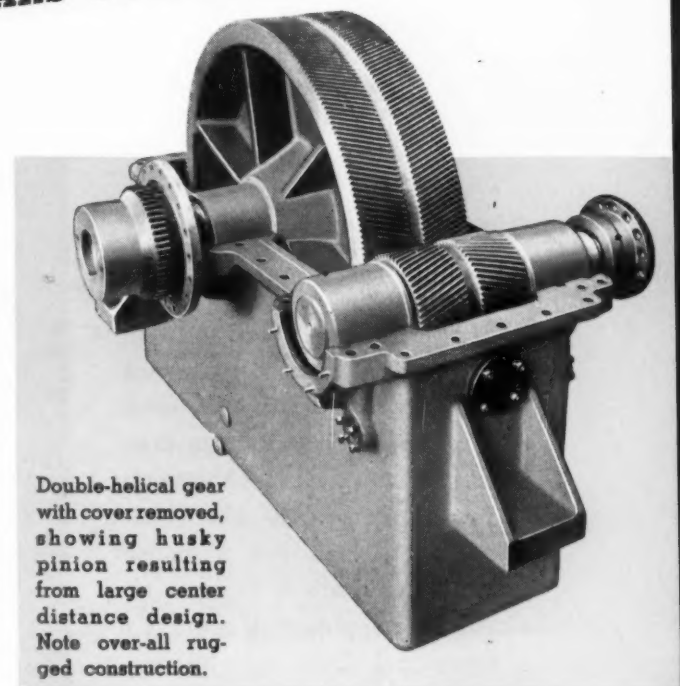
ACCURATE TEETH. Gear cutting is conducted scientifically from drawing board to test floor. Westinghouse hobbers maintain extreme accuracy. No scraping, lapping or buffing is permitted. After assembly with its turbine, each gear is given a running test and noise checkup.

LOW TOOTH DEFLECTION. By using a relatively narrow active tooth face width and a relatively large distance from the pinion centerline to the gear centerline, Westinghouse obtains unusually low tooth deflection. The resulting conservative tooth pressures are a vital factor in trouble-free operation.

ADEQUATE LUBRICATION is provided by a circulating oil system. A spray of oil is directed into the meshing teeth to assure ample lubrication at the tooth contact.

No matter what steam drive problem you may have, come to Steam Headquarters. Here is industry's most complete line of turbines, gears and steam auxiliaries . . . competent engineering help . . . and a convenient, nationwide service organization of steam experts. Westinghouse manufacturing capacity is and will be adequate for both national defense and commercial production.

J-50438



Double-helical gear with cover removed, showing husky pinion resulting from large center distance design. Note over-all rugged construction.

WRITE FOR THE BOOKS YOU WANT. Booklet 2230-A on single-stage turbines; Booklet 2278 on coupled gears, and Folder 8603 on integral gears.

1. EQUIPMENT

A *complete* range of steam turbines for mechanical or generator drive, from 5 hp up . . . with a full line of reduction gears and auxiliary steam equipment.

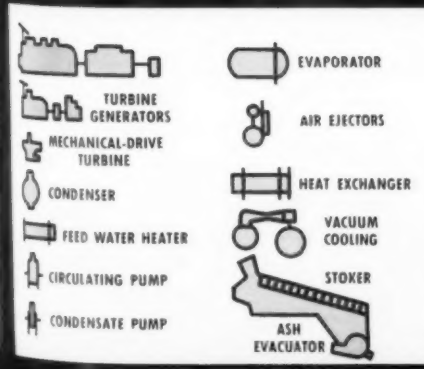
2. ENGINEERING

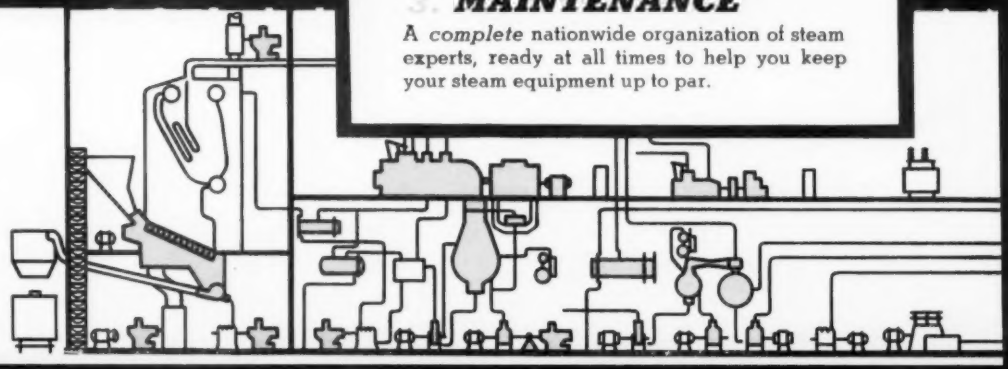
A *complete* and competent engineering service to help you select and apply the steam equipment best suited to your requirements.

3. MAINTENANCE

A *complete* nationwide organization of steam experts, ready at all times to help you keep your steam equipment up to par.

THE STEAM HEADQUARTERS LINE IS COMPLETE





STEAM HEADQUARTERS

WESTINGHOUSE

Coal chutes must carry acids, too...

A lot of engineers have unnecessary trouble with coal chutes because they designed them just to carry *coal*. That's not enough.

The best of steam coal contains some sulfur, and what you're using today probably carries more than usual. Moisture may leach this out, to form sulfur acids which eat ordinary materials like a mouse eats cheese. There is likely to be a brisk little acid-factory operating in every coal chute, larry-hopper, conveyor, or bunker.

Byers Wrought Iron has an earned reputation for fighting this corrosion and has long been recognized for its lasting qualities by experienced specifiers of materials. The balanced combination of high-purity iron and a multitude of tiny threads of glass-like slag retard and diffuse corrosive attack. The slag also helps to anchor the protective scale, and so slow up any further destructive action.

There is no occasion today for compromises in obtaining materials for corrosive services like fuel handling. While Industry was in the stage of organizing for war, there were times when even such essential requirements as those of power plants had to be sidetracked to take care of military needs. Today this situation has largely corrected itself. Practically every power plant is playing a vital enough part in the war program that proper material can be speedily obtained . . . and the job done *once* because it is done *right*.

Our Engineering Service Department will be glad to give you the detailed experience of other engineers with wrought iron. For a quick overall picture of the e tire problem, ask for our technic bulletin, "Wrought Iron for Fl Gas Conductors and Coal Ha dling Equipment."

A. M. Byers Company. Est lished 1864. Offices in Pittsbur Boston, New York, Philadelph Washington, Chicago, St. Lo Houston, Seattle, San Francisco.

Corrosion costs you MORE than Wrought Iron

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS

POWER

PHILIP W SWAIN, EDITOR ESTABLISHED IN 1882

AMERICA NEEDS MEN

RECENTLY the leaders who direct America's war production and ship program invited a small group of industrial editors, including *Power's,* to Washington for a man-to-man talk. They told us how the War goes at home and abroad, and asked us to pass the word along. Here are thoughts for power men:

First, we should recall a military lesson that every engineer will understand. It's what football fans call the "power drive." In war that means building up overwhelming superiority of mechanized might, then hitting the line hard.

Germany worked it well in 1940 when her Panzer steam rollers flattened the map of Europe in a few weeks, with trivial toll of Nazi lives. Lucky for us, the Prussian experts overlooked a few points. For one thing, they showed us that America's industrial world leadership needed only time and the will to make her the greatest military power in a war of machines.

What the Nazis should have feared has happened. England, Russia and a bit of good luck gave us time to swing the whole economy from peace to war. The men and women of American industry dug in to produce more and better weapons than the world had ever known. For many months their endless streams of equipment and supplies have been flowing to battle fronts all over the globe.

Now, we men in industry begin to see what this mass production means in terms of our sons and brothers. Better provided than any General in history, Eisenhower comes along with "too many" planes and tanks, too many trucks and jeeps, too much first-class artillery, soldiers better fed and better clothed than need be, backed by too many ships bringing up more supplies than are needed.

What's the result of all this "extravagance?" Overwhelmed by air bombs and the machinery of land warfare, the enemy is pushed into the sea off Tunisia, quickly fades away in Sicily. Italy runs up the white flag and we're on our way with a real second front.

Because we planned big and produced and delivered accordingly, British and American feet are planted firmly on the soil of Europe at lower cost in lives than had seemed possible.

It wasn't easy. Despite confusion and red tape, the men of industry accepted "impossible" assignments, fought acute shortages of tools and materials and delivered the goods.

Today the tides of battle run strong for the United Nations. All signs point to a European victory in 1944 if the latest "bottleneck" can be smashed. This time it's not materials or tools, but manpower — now perilously short in shipyards, plane plants and all types of munition production.

Already the drive is on to get more men and women into war jobs, and to reinspire those who have grown weary from long months of heavy slugging. Everywhere methods of hiring and training workers are being overhauled. Management and labor are being asked to work together to eliminate every obstacle to top production.

The production job set by Army and Navy for the last quarter of 1943 is so tough as to seem impossible of accomplishment. It will mean breaking all world records in the face of growing home-front restrictions and difficulties.

But one thing is sure: the production of these months will set the pace of all power drives on the battlefronts of 1944. How many ships, planes and guns we make will determine how long it takes your boy and your neighbor's boy to march to Berlin. It will decide how many boys will come home to enjoy the peace—and how many will die.

MODERN BOILERS FOR STEEL-MILL PLANTS

M H Kuhner, Riley Stoker Corp, shows how solution of special design problems permits construction of high-capacity steam-generating units to burn blast-furnace gas and supplementary fuels efficiently

▶ TWENTY-FIVE YEARS AGO, boiler houses of most blast furnaces had long rows of small-capacity boilers. A number burned blast-furnace gas only; the rest, coal or other common fuels. Often gas-burning boilers could not take all the blast-furnace gas and excess exhausted to the atmosphere while other boilers at full load consumed costly purchased fuel. Large units with water-cooled furnaces were frowned on because efficient combustion of blast-furnace gas supposedly required heat re-radiation from refractory furnace walls. The following facts supported this theory:

(1) Ignition temperatures are high compared with other gases; (2) theoretical flame temperature is much lower than that of coal or oil; (3) three-quarters or more of blast-furnace-gas weight entering the furnace is inert, the remaining combustible portion being mainly carbon monoxide.

With burners for blast-furnace gas not fully developed, the opinion that it had to be burned in bricklined furnaces was undoubtedly justified. Usually gas entered the furnace through large pipes in heavy solid streams. Combusion air penetrated the streams with difficulty, and the flame was long and not too stable. Steam load swings were hard to handle, preferably taken by coal- or oil-fired boilers. With solid refractory walls and constant firing rate, furnace conditions were tolerably safe.

Improved burner designs permitted use of completely water-cooled furnaces. Basically, the improvements involved dividing gas and air streams into thin layers, allowing air and gas to mix thoroughly in or near the burner nozzle. Improved burner design and maintenance of correct fuel-air ratio made heat-reflecting brick walls unnecessary.

Large steel producers then found it advantageous to centralize power generation in efficient high-capacity units in one or two large stations, strategically near the blast furnaces, each station serving a group of mills. One large plant with modern high-capacity steam and power units represents not only lower initial investment but also much lower maintenance and operating costs than a number of plants with many small boilers and generators. Moreover, the large plant uses heat in available fuel to much better advantage. Some of the central power stations in steel mills exchange electric power with similar stations and public utilities.

With this system, uninterrupted availability and reliability are of prime importance. The central station must deliver power even though one of the blast furnaces supplying gas for the boiler house is out of service. Supplementary fuel becomes a necessity because only gas in excess of that used by hot-blast stoves and gas engines is available. The economics do not permit standby boilers solely for supplementary fuel; instead, large steam-generating units normally fired by blast-furnace gas must handle supplementary fuel. And because supplementary-fuel cost is generally many times greater per unit of heat value than blast-furnace-gas cost, higher efficiency is necessary.

Most high-capacity steam-generating

TABLE I—CHARACTERISTICS OF FUELS USED IN STEEL-MILL BOILERS

Fuel	Analysis by weight, %													Heat value, Btu per lb	Comparative over-all efficiency of same boiler unit, %	Excess air for combustion, %	Fuel consumption, lb per million Btu recovered in steam generation	Combustion gas leaving furnace, lb per million Btu recovered	Weight of combustion gas compared with coal, %	CO_2 in combustion gas, %
	Carbon C	Hydrogen H_2	Sulphur S_2	Carbon monoxide CO	Methane CH_4	Ethylene C_2H_4	Ethane C_2H_6	Benzene C_6H_6	Carbon dioxide CO_2	Nitrogen N_2	Oxygen O_2	Ash	Moist.							
Blast-furnace gas	.....	0.16	....	23.49	Trace	....	....	....	21.51	54.84	....	Trace	Trace	1,140	82.0	18	1071.0	1873	162.0	24.5
Natural gas	.....	....	....	.....	84.30	....	4.80	....	2.40	8.50	....	.....	....	21,270	82.5	10	57.0	1015	87.7	10.5
Coke-oven gas	.....	9.40	....	15.80	45.00	6.70	....	7.00	7.00	8.40	0.70	.....	....	19,915	82.0	15	61.3	1000	86.4	9.4
Fuel oil	87.63	9.61	1.30	.....	.....	....	....	....	....	0.78	0.58	0.10	....	18,140	86.0	15	64.1	1055	91.1	14.3
Pa. bituminous coal	79.03	4.13	1.58	.....	.....	....	....	....	....	1.65	1.61	10.00	2.00	13,800	86.0	22	84.3	1158	100.0	15.3

MAX H KUHNER began a long career in steam-power engineering by working on the development of the first commercial 1500-psi natural-circulation boiler, after graduation from the University of Karlsruhe in 1921.

In 1925 he took charge of the Engrg Dept of Badenhausen Corp and held the position of Chief Mechanical Engineer until the consolidation in 1931 with Riley Stoker Corp. At that time he went to Riley's headquarters at Worcester as Chief Mechanical Engineer in charge of design and development of steam generating and fuel-burning equipment.

Author of many papers and holder of close to 100 patents in the power field, Mr. Kuhner is a member of ASME and engineering societies in Europe and holds professional licenses in several states.

units, now under construction or installed in steel mills within the last five or six years, use supplementary fuels with blast-furnace gas. Table I gives analyses of five typical fuels, based on percentage by weight to permit direct comparison. Table II shows the fuels used in a number of recent steam-generating units. The plants, whose names and exact locations are withheld by war censorship, are in Pennsylvania, Illinois, Michigan, and Texas.

The plant table also shows steam conditions. Pressures and temperatures, in general, run lower than for central stations, but all these boilers supply steam to turbines for power generation. As is usual in steel mills where steam and power requirements swing between wide limits, sudden load surges come on boilers without warning. Along with the need for flexibility in fuel-burning equipment, it is important to recognize possible disturbances within the boiler pressure system during rapid load changes. The circulatory system of boiler and waterwall tubes must be more liberally designed than for the usual central-station boiler, and it is wise to provide greater than "standard" steam release space in the drums. Fig. 3 to 8 illustrate the characteristics of typical combination-fired boilers for the steel industry.

In combination-fired units, these factors require special attention: (1) furnace design, (2) superheater design, (3) control of combustion air, (4) supplementary-fuel arrangements, (5) induced-draft-fan power, (6) combustion-air temperature, and (7) burner design.

TABLE II
STEAM CONDITIONS AND FUELS BURNED IN RECENT STEEL-MILL BOILER UNITS

Fig. No.	No. of Units	Capacity, each, lb per hr	Pressure, psi	Temp, F	Fuels burned
5	2	100,000	425	700	Blast-furnace and coke-oven gas; coke breeze
3	1	450,000	500	750	Blast-furnace gas; pulverized Eastern bituminous coal (oil for pilot burners)
	1	150,000	400	700	Blast-furnace gas and oil; future pulverized coal
	2	175,000	300	700	Blast-furnace and coke-oven gas; pulverized coal
6	3	300,000	680	760	Blast-furnace gas; pulverized coal (oil for pilot burners)
4	2	440,000	480	790	Blast-furnace and coke-oven gas; pulverized high-volatile bituminous coal
7	1	36,000	285	715	Blast-furnace gas; lignite on traveling-grate stoker
8	1	125,000	420	750	Blast-furnace, coke-oven, and natural gas

Furnace Design: Blast-furnace gas delivered to boilers may contain from 0.1 to 2.4 grains of dust per cu ft gas, depending on the extent of gas cleaning. Iron forms over 40% of the dust. In burning pulverized coal with blast-furnace gas, some slagging develops even if furnace temperatures are kept below coal-ash fusion temperatures. Apparently the iron in blast-furnace-gas dust acts as a flux on coal ash.

In boilers combining blast-furnace gas with pulverized coal, low furnace-heat-release rates are important; a rate of 22,000 Btu cu ft per hr is none too low if the furnace is completely water cooled. Furnace shape is of still greater importance. Distance from blast-furnace-gas burner to combustion-gas exit must allow time for complete combustion, which is many times greater for lean blast-furnace gas than for richer natural or coke-oven gas. The furnace should be so proportioned that combustion gas approaches the exit at a velocity no higher, and preferably somewhat lower, than in a pulverized-coal furnace. For every pound of steam generated with blast-furnace gas almost two pounds of combustion gas moves through the furnace.

It is basically sound in pulverized-coal installations to provide for low velocities of combustion gas entering boiler and superheater passes. If the momentum of dust particles in the gas is kept low, impact on heating surfaces is so far reduced as generally to prevent slag and dust deposits on tubes. Fused and semi-liquid dust particles leaving the furnace in the combustion gas gradually become chilled while slowly drifting over tube surfaces. Low gas velocity becomes an even more important requirement for combination firing of blast-furnace gas and pulverized coal because not only are large quantities of dust carried in combustion gas, but the dust tends to liquefy part of the coal-ash particles. Thus, danger of slag and ash deposits on boiler and superheater tubes is greater.

Provision must be made for continuous discharge of ash in dry form, because during operation of wet furnace bottoms, with blast-furnace-gas rates high and pulverized-coal-burning rates low, it would be difficult if not impossible to melt ash on the furnace floor. In any event, the large quantity of inert gas introduced with blast-furnace gas lowers furnace temperature. In spite of

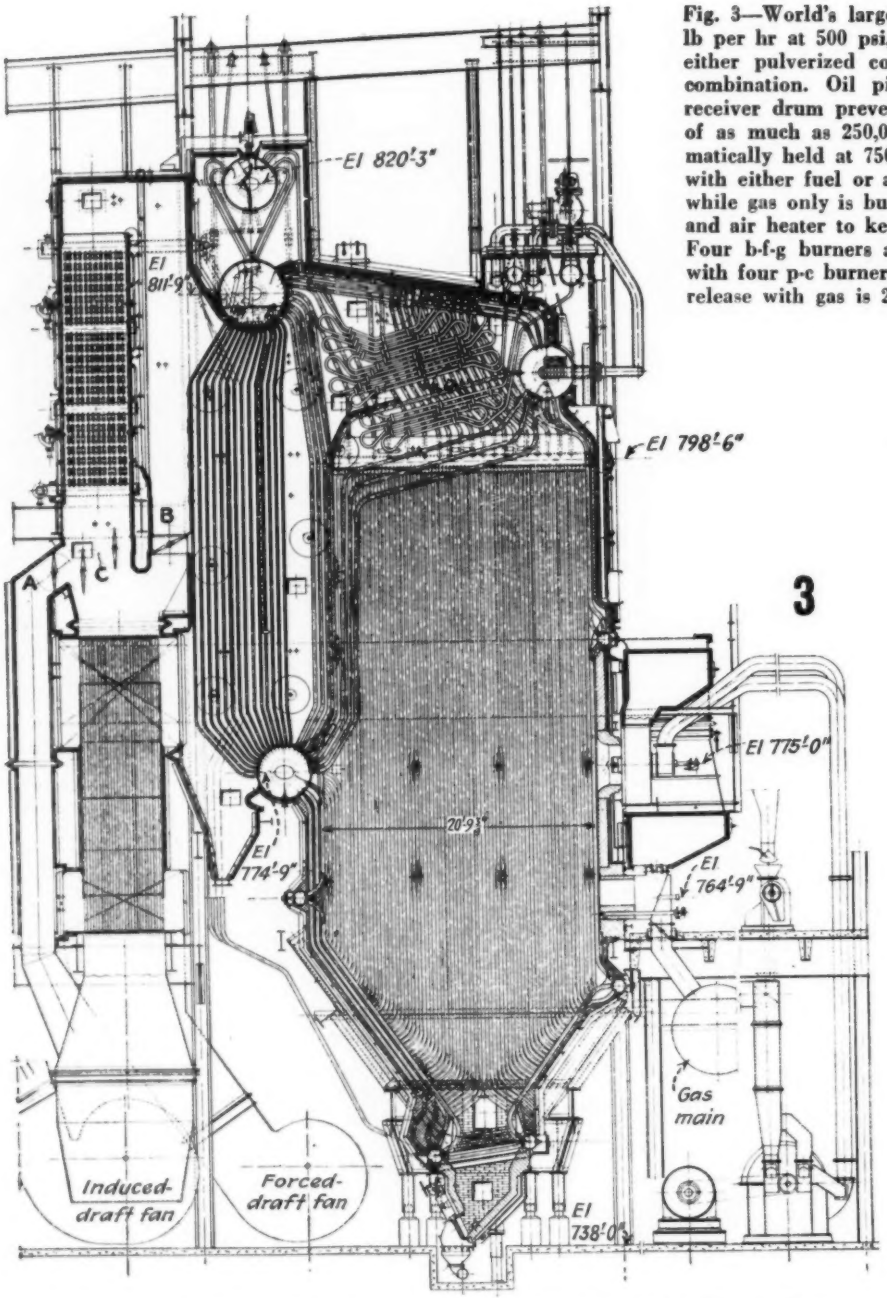


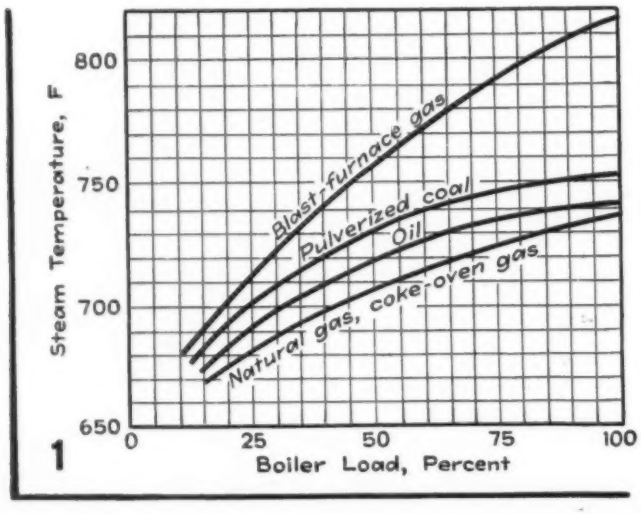
Fig. 3—World's largest steel-mill boiler unit develops 450,000 lb per hr at 500 psi, 750 F. Full steam output produced with either pulverized coal or blast-furnace gas, separately or in combination. Oil pilots are used for b-f-g burners. Steam-receiver drum prevents possible carryover during load swings of as much as 250,000 lb per hr. Steam temperature is automatically held at 750 F for any load above 200,000 lb per hr, with either fuel or any combination. Above 400,000 lb per hr, while gas only is burned, part of flue gas bypasses economizer and air heater to keep required fan suction below 10 in. H_2O. Four b-f-g burners are directly above hoppered furnace floor with four p-c burners 10 ft above b-f-g burners. Maximum heat release with gas is 20,900 Btu/cu ft/hr

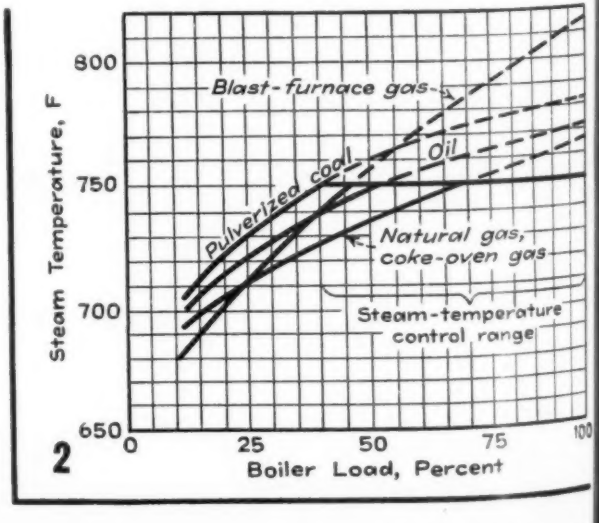
possible fluxing action of blast-furnace-gas dust with coal ash, it is doubtful that ash can be sufficiently liquefied for reliable discharge from a wet-bottom furnace even during highest steam load.

Superheater Design: Quantity of combustion products leaving the furnace is 60 to 90% greater with blast-furnace gas than with oil or coal. Among many factors affecting superheater performance, mass gas flow over the surface is one of the most important. If combustion-gas temperature passing over the surface were the same, resulting steam temperature would be much higher with blast-furnace gas than with coal or other fuels. With gas-bypass dampers to control steam temperature, up to 50% of combustion gas from blast-furnace gas would have to bypass around the superheater, to have the steam temperature about equal to that obtained when all combustion gas of coal or oil passes over the superheater surface. Large bypass dampers and blank gas passages make the arrangement impracticable.

In the characteristic curves of steam temperatures for various fuels, Fig. 1, blast-furnace gas produces a steeply rising curve because heat is absorbed by convection only, but curves of other fuels show some of the combination convection and radiant heat-absorbing

Fig. 1—Characteristic steam-temperature curves for various fuels. Fig. 2—Temperature curves with gas-bypass or desuperheating control over upper range





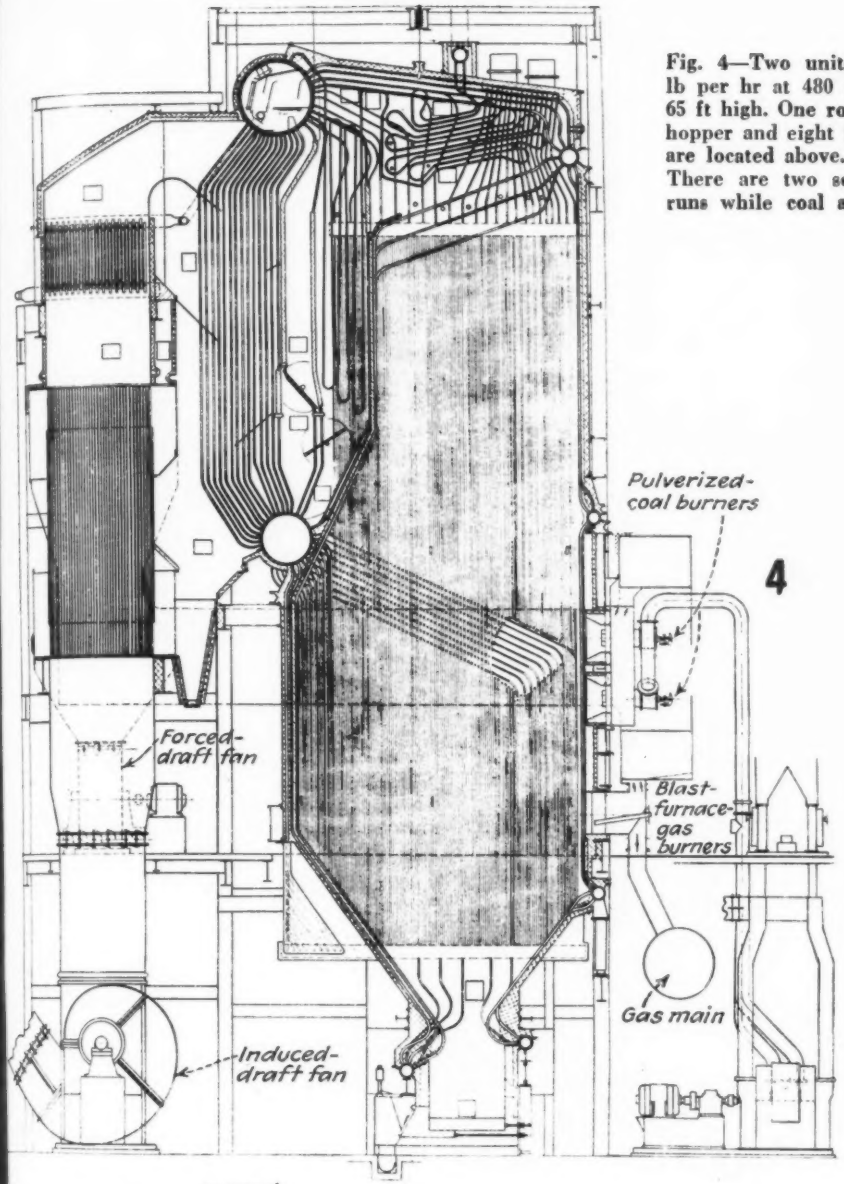


Fig. 4—Two units under construction will generate 440,000 lb per hr at 480 psi, 790 F. Furnace is 32 ft wide and over 65 ft high. One row of b-f-g burners stands just above furnace hopper and eight flare-type burners for coal and coke-oven gas are located above. Bypass dampers control steam temperature. There are two sets of motor-driven fans; only one i-d fan runs while coal and coke-oven gas carry the load

characteristics. Temperatures shown in Fig. 1 would be obtained in a steam-generating unit if all fuels were burned through one combination burner, or if all burners were equally distant from the superheater surface. Placing supplementary-fuel burners close to the superheater and blast-furnace-gas burners at a greater distance keeps steam temperature more uniform with fuel fired individually or in combination. A steam-temperature control system, of either gas-bypass, Fig. 4, or desuperheating type, Fig. 3, is then employed only to level out the natural steam-temperature rise obtained with each fuel over the higher load range. Resulting steam-temperature curves are then like those in Fig. 2.

In superheater design and placement stickiness of dust carried in combustion gas is important both for combination firing of blast-furnace gas and pulverized coal and for dirty blast-furnace gas alone. It is well known that adherence of flyash to a heating surface is affected by surface temperature: the higher the temperature, the easier the dust sticks. Troublesome fouling of superheater surface may result, especially in high-temperature superheaters which must be placed in the high gas-temperature zone. Wide vertical and horizontal spacing of superheater tubes and access to the surfaces for hand lancing are important. The superheater must not be nested among boiler tubes, and above all dust and slag must not bridge between tubes.

Control of Combustion Air: When one or more supplementary fuels are burned with blast-furnace gas, combustion control and maintenance of correct fuel-air ratio are more involved than for a single fuel or a combination of similar fuels. Table I shows, for example, that products of efficient combustion of blast-furnace gas contain 24.5% CO_2; those of an Eastern bituminous coal 15.3% CO_2. Obviously, a CO_2 indicator or recorder would be a poor guide for combustion-air regulation if

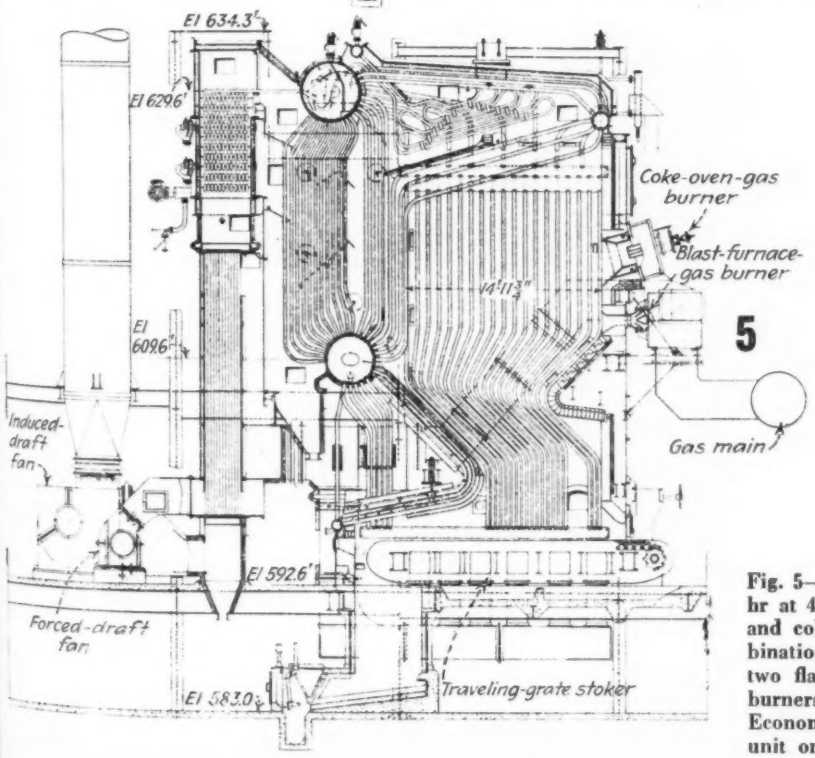


Fig. 5—This steel-mill boiler generates 100,000 lb per hr at 425 psi, 700 F. Blast-furnace gas, coke-oven gas and coke breeze are burned separately and in combination; a traveling grate handles coke breeze. The two flare-type coke-oven-gas burners, above the b-f-g burners, are designed for future pulverized-coal firing. Economizer and air heater are used; efficiency of unit on blast-furnace gas is over 84%

the two fuels were burned simultaneously in different proportions.

About 800 lb of air must be supplied to the burner to develop 1,000,000 Btu in steam with blast-furnace gas, and about 1070 lb for coal. Since air-flow control from steam flow would be incorrect, fuel rate must control combustion air supplied to burners so that air delivered to blast-furnace-gas burner is in correct ratio to gas it burns; and air supplied to burners for pulverized coal or other auxiliary fuels is in direct ratio to these fuels' burning rate. This requires independent air supply systems to the individual burners.

With blast-furnace-gas burners separate from supplementary-fuel burners, the problem is more readily solved by simply dividing the air from one common duct among the individual burners. Air-flow dampers, controlled from fuel rate, proportion air quantities delivered to the burners. In larger installations, automatic control maintains the fuel-air ratio. Gas-pressure drop over an orifice, in the main supply blast-furnace-gas duct, positions the dampers supplying air to the gas burners while a master controller from steam pressure controls gas flow to the burners. In some cases an interlock is provided between supplies of blast-furnace gas and supplementary fuels. If pressure in the blast-furnace-gas duct drops so low that stable burner operation is endangered, air and gas flow to blast-furnace-gas burners automatically stops, while supplementary-fuel burners take over steam load.

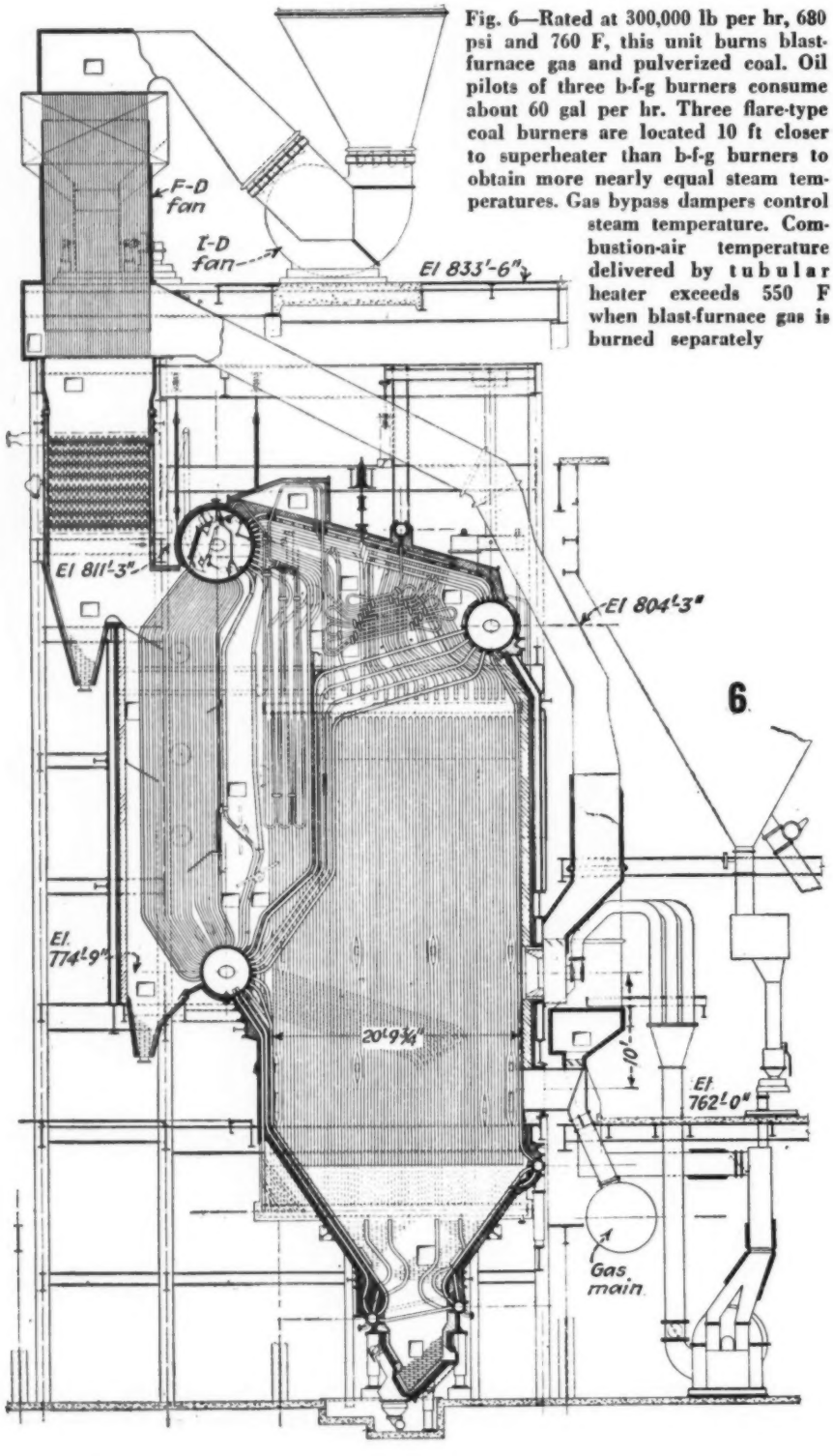


Fig. 6—Rated at 300,000 lb per hr, 680 psi and 760 F, this unit burns blast-furnace gas and pulverized coal. Oil pilots of three b-f-g burners consume about 60 gal per hr. Three flare-type coal burners are located 10 ft closer to superheater than b-f-g burners to obtain more nearly equal steam temperatures. Gas bypass dampers control steam temperature. Combustion-air temperature delivered by tubular heater exceeds 550 F when blast-furnace gas is burned separately

Supplementary Fuels: In some plants, blast-furnace-gas supply may be interrupted without previous warning. Of course steam and power interruption cannot be tolerated, especially if a power plant serves a number of outlying mills. If coke-oven gas, natural gas or oil is the supplementary fuel, any one can quickly take over steam load, but a pulverized-coal installation must be designed to permit instantaneous change from gas to coal without change in steam-output rate.

Under the bin system pulverized coal is available near the burners for instant use, but it is cumbersome and expensive. Most modern steam-generating units for blast-furnace gas combined with pulverized coal are equipped with unit mills for direct firing. Where sudden, unannounced interruptions of blast-furnace-gas supply are anticipated, pulverizers are kept running at full speed and with coal feeders closed. The moment gas supply drops below a safe rate, an impulse sent from blast-furnace-gas pressure to the coal feeder starts the feeder motor and within a few seconds pulverized coal reaches the burners. In recent tests a pulverized-coal flame was established only four seconds after the coal-feeder motor started to turn.

Running a pulverizer idle takes power but amount to spin the rotor of at least one type of mill is comparatively small, and an economic study will show whether assurance of uninterrupted steam supply justifies power cost.

In one plant, pulverizer-drive motors start automatically on a control-system impulse from blast-furnace-gas pressure. Sequence is as follows: (a) When gas pressure drops to a predetermined value in the main blast-furnace-gas duct, a control impulse starts pulverizer motors. (b) If gas pressure continues to drop, reaching a second point, the control starts feeder motors. Coal flows to the mills, and a few seconds later flame is established. In this plant, oil pilots remain permanently in service.

Induced-Draft-Fan Power: Combustion gas passing over the heating surfaces while burning blast-furnace gas runs approximately 70% greater for a given steam output rate than for most other fuels. Gas passages of a steam-generating unit can be proportioned to the volume of combustion gas from blast-furnace gas, which results in comparatively large physical dimensions and greater initial installation cost but also in a reasonably low over-all draft loss and therefore lower fan-power requirements. Or the gas-passage areas may be proportioned more in relation to combustion-gas volumes produced by supplementary fuels, and in that case the equipment's physical dimensions will be less and initial cost lower. But draft losses through the system and the required induced-draft-fan power will be as much as 2½ times greater. It simply means balancing initial investment against cost of induced-draft-fan power.

In Fig. 3, sizes of induced-draft-fan motors were cut in half by arranging heat-recovery equipment (economizer and air heater) so that during highest steam-output rates with blast-furnace gas, part of the combustion gas can bypass economizer and air heater. Maximum steam loads can be carried with pulverized coal alone and with the full use of economizer and air heater. The slight sacrifice in efficiency by only partial use of heat-recovery equipment can be tolerated with low-cost blast-furnace gas during top-load operation.

Fig. 3 shows four dampers placed between economizer and air heater. During normal load with either fuel and during top load with pulverized coal, dampers are positioned as shown, and all combustion gas passes first over the economizer, then through the air heater. An independent, automatic control system takes its impulse from the static suction in the inlet boxes of the induced-draft fan. The control is so set that when the maximum static suction (in this case 10 in. H_2O) is approached in the inlet boxes of the induced-draft fan, damper *A* slowly opens while dampers *C* start to close to maintain a pressure differential of approximately 0.2 in. H_2O between the economizer's gas exit and the entrance to the air heater. Thus, part of the gas passes directly from the economizer into the inlets of the induced-draft fans.

If a further reduction of static loading is required with increase of steam

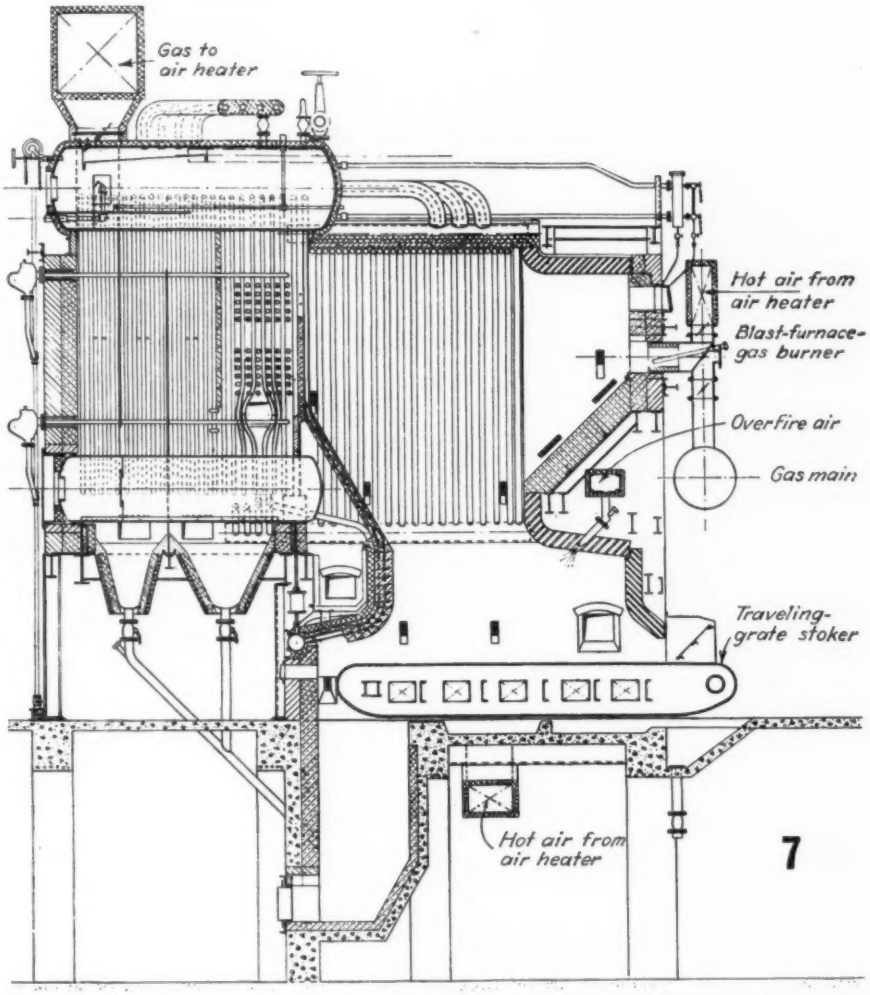


Fig. 7—This small unit (36,000 lb per hr, 285 psi, 715 F) burns blast-furnace gas and high-ash high-moisture lignite; efficiency is 78% on gas. Superheater is in first gas downpass; economizer is integral; tubular air heater stands alongside

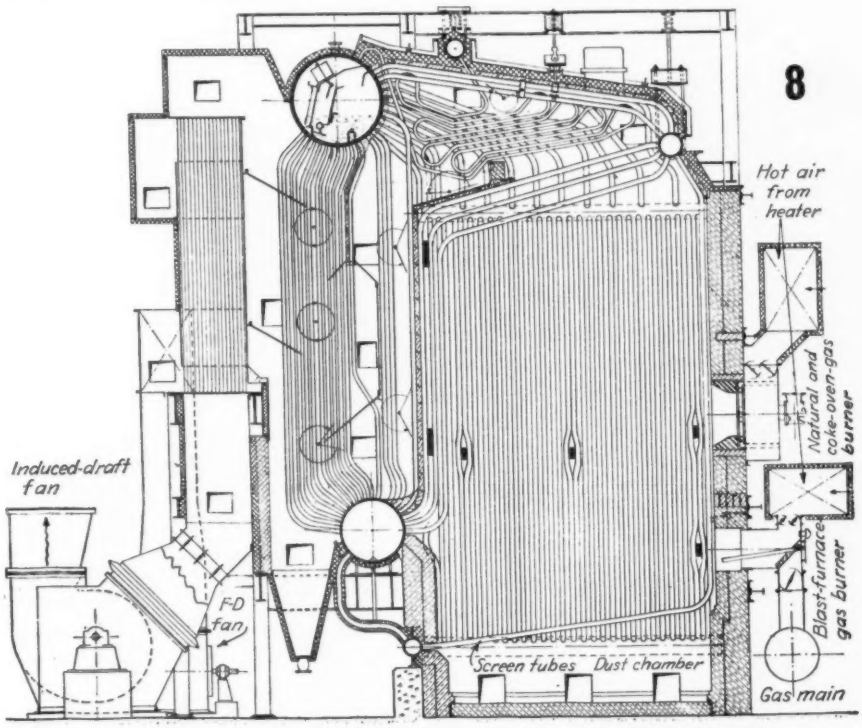
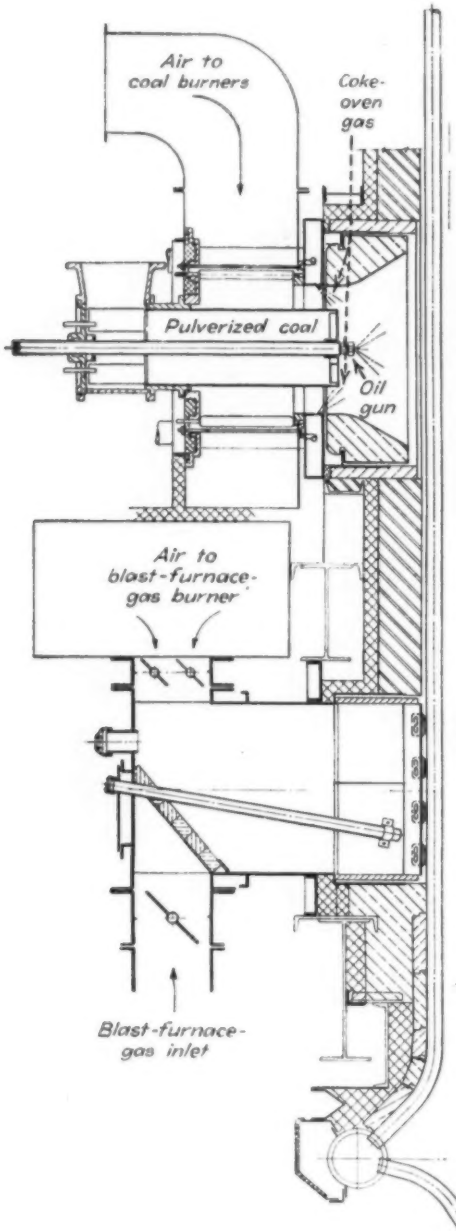
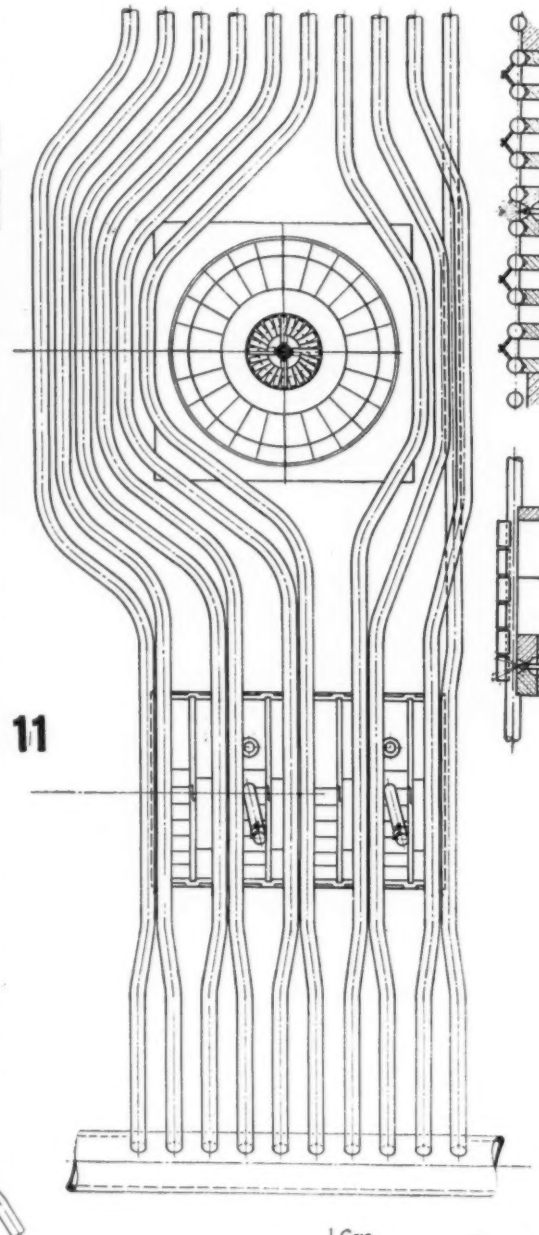


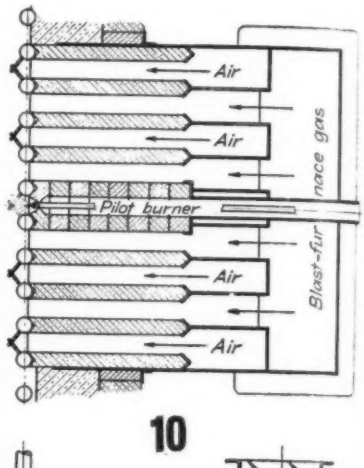
Fig. 8—In this 125,000-lb-per-hr 420-psi 750-F unit, combination coke-oven and natural-gas burners are 8 ft nearer superheater than b-f-g burners, which have natural-gas pilots. Blast-furnace-gas dust content will run less than 0.10 grains per cu ft; a simple floor screen is placed above an ash-settling chamber from which dust will be removed manually

output, the control continues to open damper *A* and also damper *B*, so that part of the combustion gas bypasses the economizer as well as the air heater. Because this control system is entirely independent of any other control and is fully automatic, it provides reliable protection against overloading of induced-draft-fan motors and insures gas bypasses being used only during top steam-output rates while blast-furnace gas alone is burned.

Combustion - Air Temperature: The most modern steam-generating units, for blast-furnace gas alone or combined with other fuels, are equipped with air heaters for preheating combustion air by heat recovered from flue gas. Heated combustion air is beneficial for combustion of all common fuels, and air heaters are, after all, the least costly heat-recovery apparatus to use with steam-generating units. Although heated combustion air for burning blast-furnace gas is desirable to generate steam more economically, its principal value







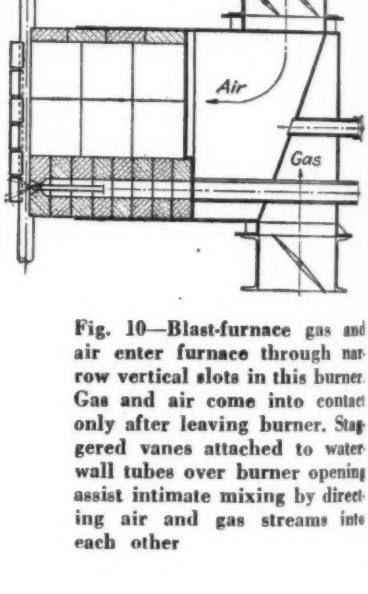
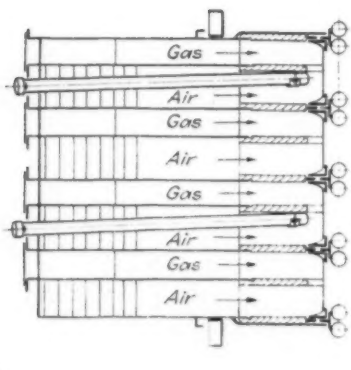


Fig. 10—Blast-furnace gas and air enter furnace through narrow vertical slots in this burner. Gas and air come into contact only after leaving burner. Staggered vanes attached to water-wall tubes over burner opening assist intimate mixing by directing air and gas streams into each other



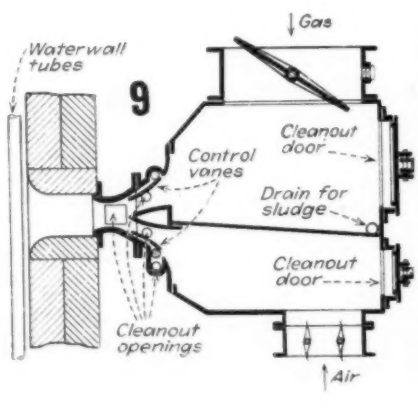


Fig. 9 (left)—In this blast-furnace-gas burner of the premix type, gas and combustion air enter a mixing nozzle in thin wide streams. Hand-operated vanes in the nozzle control stream thickness and assist in producing turbulence. Burners of this type are installed on boilers of Fig. 5. Fig. 11 (above, left)—This blast-furnace-gas burner is a modification of Fig. 10. Gas and air premix in the nozzles. Water-wall tubes between burner openings shield internal parts from furnace heat. Flare-type burner above handles pulverized coal, coke-oven gas, and oil, alone or in combination.

is to improve combustion conditions.

It is not difficult to obtain combustion-air temperatures as high as 550 to 600 F with a comparatively small air heater while burning blast-furnace gas. The great difference in weight between flue gas and combustion air produces about 250 F air-temperature rise for every 100 F gas-temperature drop. With coal firing, corresponding figures are 130 F air-temperature rise per 100 F gas-temperature drop. In either case, assume that all combustion gas passes through the air heater and that about 95% of all combustion air is heated.

Burner performance proves that a shorter, more stable flame is produced when preheated air, instead of room-temperature air, is used to burn blast-furnace gas. The reason is probably twofold: Volume of a given weight of air at 550 F is almost double that of the same weight at 70 F. The larger volume of combustion air of lesser density mixes more thoroughly with the gas to be burned so that oxygen in the air comes quickly in intimate contact with combustible gas. Hot air raises the mixture's temperature and thus accelerates combustion.

Burner Design: If a blast-furnace-gas burner is separate and independent, it can be arranged for best results without allowances for requirements of other fuels. The one detail that the burners in Fig. 9 to 11 have in common is provision for convenient cleaning of the gas compartments. Frequency of periodic cleaning depends on dust loading and stickiness of dust. To reduce the time the burner is out of service because of cleaning, access to gas compartments through gas-tight cleanout doors must be quick and convenient. See captions (Fig. 9-11) for burner details.

STEEL-MILL BOILER DESIGN—SUMMARY

1. Furnace design must be as liberal as for boilers fired by pulverized coal, to permit complete gas combustion

2. Extensive water cooling is desirable, especially for blast-furnace gas combined with pulverized coal, because dust carried in gas appears to flux coal ash

3. The large portion of non-combustible gas in blast-furnace gas requires thorough, intimate mixing with combustion air to insure complete combustion

4. Preheated air is desirable because larger air volume insures more thorough mixing with gas; the higher temperature of gas-air mixture accelerates combustion

5. More uniform steam temperature from high-temperature superheaters is obtained by placing auxiliary fuel burners closer to the superheater

6. Closer control of fuel-air ratios for each fuel is possible with blast-furnace-gas burners that are separate and independent of auxiliary burners

7. Combustion-gas weight from blast-furnace gas is 60 to 90% greater for a given steam output than for any other common fuel. Therefore, gas passages and induced-draft fans must be larger and water-heating surface greater

8. Used most efficiently, blast-furnace gas for steam generation results in attractive fuel-cost savings. It is wrongly called a waste fuel; rather, wherever it is available for steam generation it is a principal fuel. Because each plant's problems are different, a thorough study of conditions and requirements, both physical and economic, must precede auxiliary-fuel selection.

A recent combination burner design, Fig. 12, handles blast-furnace gas, pulverized coal, coke-oven gas and oil, in combination or separately. Blast-furnace gas enters the burner through a scroll similar to a fan scroll from which the gas discharges through an annular opening into the burner throat. Combustion air is brought in through the center burner tube. The scroll-shaped gas inlet imparts rotation to gas, and curved air-inlet vanes produce rotation of combustion air in the same direction. Gas and air mix effectively in the refractory-lined burner throat.

Two such burners are in use with the 150,000-lb-per-hr boiler in Table II. This installation maintains remarkably steady flame conditions while burning blast-furnace gas without supporting fuel, in spite of a completely water-cooled furnace and wide steam-load swings. Three gas-tight doors provide access for cleaning the blast-furnace gas compartment. Although the gas in this plant has high dust and moisture loading, burners have operated during the past twelve months without being cleaned. Scrubbing action of gas flowing through the scroll-shaped inlet at comparatively high velocity seems to prevent deposits.

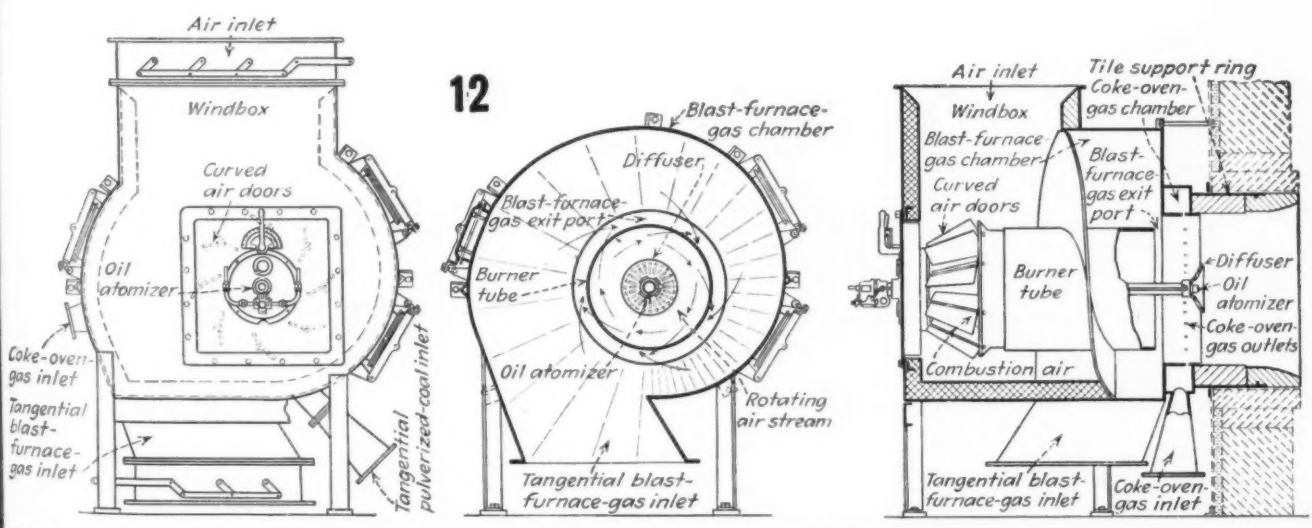


Fig. 12—A recent combination burner design: unit at left handles blast-furnace and coke-oven gas, oil and pulverized coal; burner in center is for blast-furnace gas and oil; unit at left burns blast-furnace and coke-oven gas and oil

You Can Meet WPB Regulations When Buying Material-Handling Equipment

If you are contemplating buying or repairing coal-and-ash-handling or similar equipment, here's what you must do to meet War Production Board requirements, as told by Wilbur G. Hudson, a material-handling engineer of long experience

►Faced with a serious shortage of certain engineering materials, the U. S. War Production Board set up regulatory order L-193, which limits the materials that may be used in the construction of material-handling installations, and determines whether such equipment may be installed. WPB does not direct what materials may be used, but rather what materials may not be used.

True, the order handicaps the design of certain equipment, but it is not WPB's intention to interfere with make-up and installation of needed equipment beyond conserving certain critical war materials. Under the order's provisions, alternates in materials, machinery or structures are always available. In other words, WPB seeks not to suppress but to guide manufacturer and purchaser toward less critical materials.

Storage bins and bunkers. Take, for example, storage bins and bunkers. The order directs (June 11, 1943) that: "No metal shall be used in bins, hoppers, tanks or bunkers having a capacity of more than 400 cu ft level filled, except in clips, gussets, bolts, nuts, screws, lag screws, hinges, tension bars or mesh, washers and hopper bottoms of less than 400 cu ft capacity, level filled. No liner plates of steel or rubber shall be used in steel bins, steel tanks or steel hoppers. Steel liners for wood bins or wood bunkers shall not exceed No. 10-gage thickness."

Reinforced concrete silos. Obvious intention of the paragraph just quoted is to conserve steel plate. Many bins and bunkers are for coal storage and, therefore, a monolithic concrete silo, or if necessary twin silos, may frequently be used if capacity does not exceed 500 tons. Steel is involved only for reinforcing rods, which are excepted in the above order. Since a silo costs $12 to $18 per ton of coal-storage capacity and a suspension steel bunker doubles the figures, the order would seem to cause no great hardship, especially since concrete has long life and practically no upkeep, compared with an unprotected steel-plate bunker's average life of less than 10 years, after which plates must be replaced. If coal is actively corrosive, the plates have a life of less than 2 years.

Sectional cast-iron bunkers as substitutes. Should a silo not fit the job, there are alternates, such as sectional cast-iron coal and ash bunkers, which resist corrosion better than steel plate. Ribbed cast-iron sections cost per pound about half as much as fabricated-steel plates, but they weigh more than double as much, so their cost is higher.

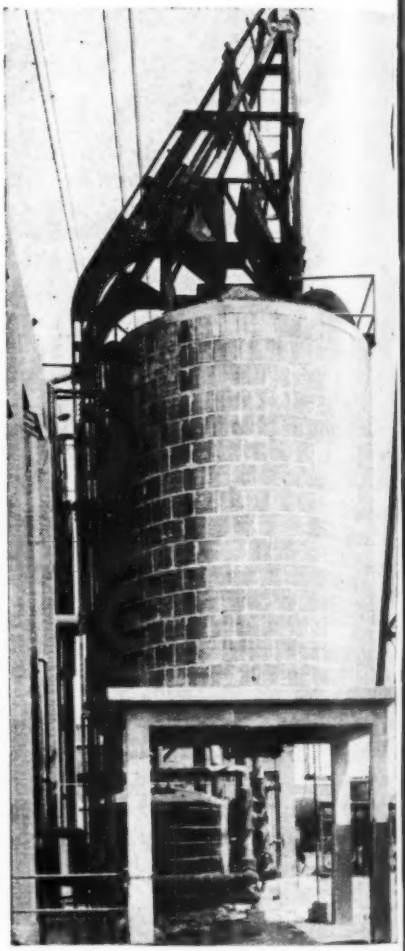
Chutes. Restrictions on steel chutes cause no difficulty. Wood chutes with cast-iron liners provide satisfactory substitutes; sometimes they are better. Chutes may also be of cast-iron pipe.

Conveying machinery. Restrictions are: Use no alloy steel or alloy iron (other than for chains for power transmission) except for (1) pins and bushings for steel conveyor chains or cast sprocket chains, or (2) chains in the heat zone of heat-treating and metallurgical furnaces to the extent permitted under order M-21-g. (This order relates to heat-resistant chromium or chromium-nickel-alloy iron or alloy steel.) No bushings other than carbon steel or gray iron shall be inserted in the bores of conveyor chain rollers.

Conveyor structures. No steel shall be used, except in clips, bearing brackets, gussets, bolts, nuts, tension rods, reinforcing bars and mesh in the following:

A. Supports for fixed conveyor frames except supports for gravity, live roll and package conveyors when height of support does not exceed 36 in.

B. Fixed belt-conveyor frames and stringers.



Skip hoist handles ashes from boiler plant to circular storage tank, the latter being built of less critical material

C. Conveyor galleries.

D. Belt-conveyor decking.

E. Walkways, toe boards, handrails, stairways, platforms.

F. Guards or housings for protection only, not those for mechanical-power transmission drives; that is, a silent-chain or roller-chain drive may have the usual steel casing.

G. Bucket-elevator casings, except corner angle irons—for self-supporting cases—and boot lining and loading legs, where steel shall not exceed ¼-in. thickness.

H. Troughs or trough covers for fixed-flight, drag-scraper or screw conveyors; except where liquids or semi-liquids are conveyed, or where trough is a structural member of the supporting framework (which seems to let in

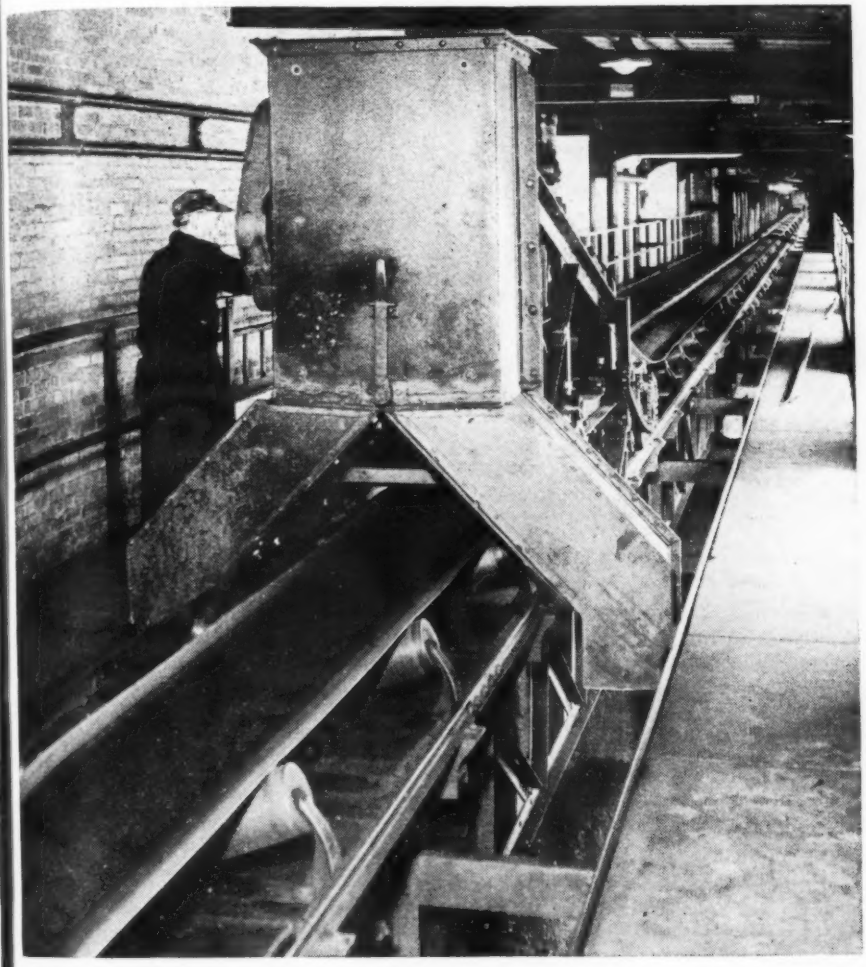
apron feeders and apron conveyors); and except repair materials. Exception for repairs does not permit using heavier steel than the original, nor replacing non-metallic parts with metal, and carbon steel with alloy steel.

1. Continuous stream, conduit-elevator-conveyor casings (en masse conveyors: Redler, Bulk Flos, etc.); except (1) terminal sections, (2) curved sections, (3) straight casings for carrying runs only, and (4) wearing bars for return runs only; but no steel exceeding $\frac{3}{16}$ in. shall be used for the excepted items.

Further requirements relating to conveyors and related parts: Fixed-conveyor trough linings shall not exceed No. 10-gage steel. Steel chutes shall not exceed $\frac{3}{16}$ in. in thickness and shall not be lined with rubber. No copper-bearing sheets or plates shall be used. Steel troughing idlers and return idlers of belt conveyors shall not exceed 5 in. in diameter for belts up to 42-in. width, and not more than 6 in. in diameter for wider belts. Rule does not apply to replacement of idlers.

Eliminating critical materials from equipment design. Intent of these regulations is clear. Without attempting to direct type of machine, they direct the manufacturer to design equipment to eliminate critical materials. Conveyor supports and galleries may be of concrete or wood instead of steel. Chain-and-gear guards may be of wallboard or asbestos-cement sheets. Elevator casings made with steel corner angles and $\frac{3}{8}$-in. asbestos-cement sheets are quite as good as sheet-steel casings. However, suitable composition must be specified because asbestos-cement sheets range from those that may be sawed like wood to a stone-hard brittle material.

Screw-conveyor troughs may have wood sides with steel bottom or cast-iron sections. Cast-iron helices have a much longer life than steel, but they cost more. Drag-chain conveyors for abrasive and corrosive materials may have hardened-faced concrete troughs.



Belt conveyors are restricted on construction and compounding of rubber covering of belts in addition to restrictions on supports, decking and diameter of rolls. Restrictions quite similar to those for belt conveyors apply to belts of belt-and-bucket elevators

Continuous-stream conveyors. Restrictions here impose rather awkward limitations and save little steel. These conveyors should have casings of at least $\frac{1}{4}$-in. steel. Return run will now be of wood, plastic or asbestos-cement sheets, and carrying run will be made so the sides may be replaced as worn. These conveyors have not reached their final development and eventually may have cast-iron terminals, bends and straight runs. The WPB order may stimulate their development.

Belt conveyors. In addition to restrictions on supports, decking and diameter of rolls, belt conveyors are restricted on belt construction by order M-15-b-1.

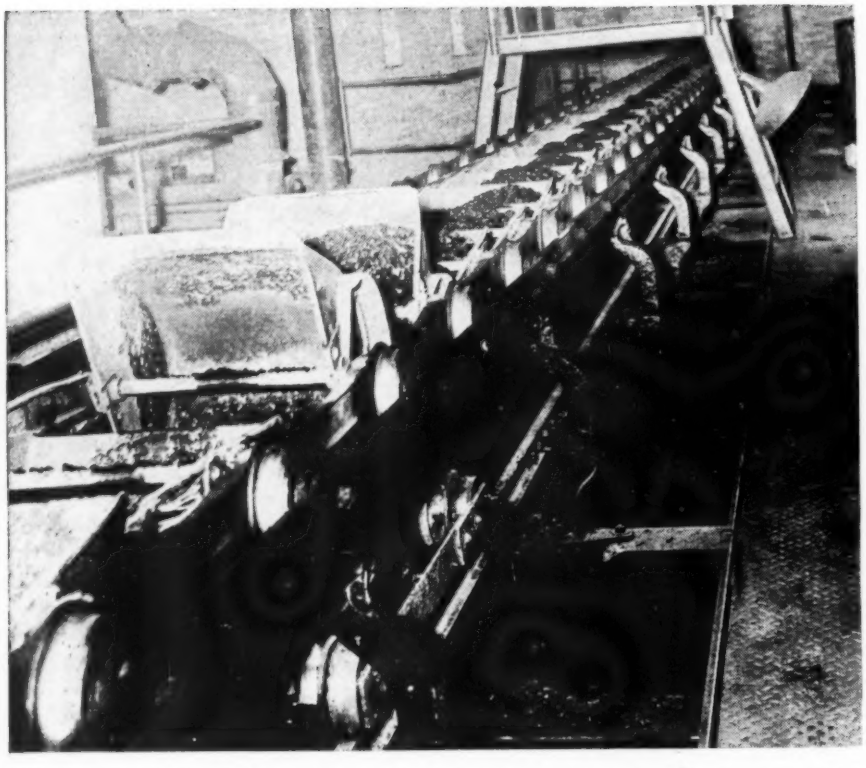
Conveyor belts are controlled thus: "Rubber belting using solid woven carcass is permitted provided such construction uses no more crude rubber or rubber hydrocarbon than is permitted in laminated belting of equivalent size and thickness. Constructions using combinations of fabric and other reinforcing materials, such as cord or wire, are permitted provided total crude rubber and rubber hydrocarbon do not exceed those which are used in an equivalent grade of fabric-ply-construction belts." Belts are graded No. 1 and 2.

Rubber covers. Total thickness must not exceed $\frac{7}{32}$ in. for No. 1 belts, but may be divided as desired. Thus, covers may be $\frac{3}{16}$ in. on the carrying side and $\frac{1}{32}$ in. on the under side. If a breaker strip is used, its gage is included in cover thickness.

Rubber belts. Only No.-2-quality belts are permitted for certain materials, and cover thickness for these is further reduced. Limiting rubber thickness on the carrying side of a conveyor belt substantially shortens its life, but saving rubber is of paramount importance now. Rubber belts for handling boxes, bales, paper, dry pulp and wood chips are prohibited. Restrictions quite similar to those for belt conveyors apply to belts of belt-and-bucket elevators, and are also detailed in order M-15-b-1.

Pivoted-bucket carriers, apron feeders and apron conveyors. They come under the regulations of order L-193 except that no restrictions are placed on the use of steel for frames. Use of steel to support frames of these conveyors is prohibited unless a waiver is requested and substantiated.

Most of the weight in a pivoted-bucket carrier is in the buckets, which are of malleable iron. Casings should be wallboard or asbestos-cement sheets. Apron conveyors and apron feeders offer little opportunity for change, ex-



A large part of the weight in a pivoted-bucket-carrier conveyor is in its buckets, which are constructed of malleable iron, connected by links and carried on rollers

cept possibly in the apron proper which might be of cast iron, malleable iron or, for lighter duty, wood sheathed with No.-10-gage steel. Skirt boards often are wood.

Skip hoists and pneumatic conveyors. These two conveyors are not covered by order L-193.

Weight of steel required in a skip hoist of average lift and capacity is much less than for the equivalent bucket elevator and eliminates the rubber involved in the equivalent inclined belt conveyor.

Pneumatic conveyors do not use steel except to house receiver and dust separator. Pneumatic boxcar unloaders and barge unloaders use a flexible rubber-lined hose. Rubber hose requirements are detailed in order M-15-b-1. Steam-jet ash conveyors use cast-iron pipe and cast-iron separators, dust collectors or air washers. For long life and resistance to abrasion and corrosion, practice has been to use nickel-alloy cast iron, but for the present ordinary cast iron will do.

Antifriction bearings. Order No. L-193 provides that: "Antifriction bearings shall not be used in hangers, pillowblocks, loose pulleys and clutch pulleys for line shafting except for the following purposes as certified by the purchaser: (A) Reduction or elimination of fire hazards resulting from the combustible nature of the material being processed. (B) Reduction or elimination of waste due to spoilage. (C) Reduction of starting or running loads where the use of antifriction bearings will correct an overload pertaining to the primary source of power. (D) Repair or replacement of bearings for line shafting provided, however, that no antifriction bearings shall be used for repair or replacement purposes for line shafting not previously equipped with such bearings."

Motors. Regulations are strict on the use of totally inclosed and explosion-proof motors. Another requirement is that any motor, which may be on hand and might be adapted to the work contemplated, must be used. Motors are not covered by order L-193, but by a separate order, L-221.

Orders of $5000 or more. Any proposed mechanical material-handling installation requiring an expenditure of $5000 or more, not including foundations and erection work, is restricted. This means that unless WPB approves the project, manufacturer or contractor may not submit a bid nor accept an order for the equipment. This applies to partial orders for less than $5000 if they are part of a planned group aggregating more than $5000.

Responsibility for violation of this provision rests with the purchaser unless manufacturer or contractor knows the project was broken down into small orders. Manufacturer or contractors can make a preliminary or approximate estimate to aid the purchaser in obtaining an authorization, but a firm bid and detailed specification must not be submitted. When asking for authorization of a project, it is helpful to give WPB approximate weight of materials needed.

Orders of less than $5000. If cost does not exceed $5000, project need not be authorized, but regardless of size, installation must conform to the restrictions quoted from L-193 unless a waiver is requested and justified. As revised June 11, 1943, there is a requirement that no person "shall accept any order for any conveying machinery or mechanical-power-transmission equipment unless order is rated AA-5 or higher."

Exceptions. If conveying machinery or mechanical drive is used on any vessel owned or operated by the Government, in aircraft or other pieces of combat equipment, no authorization is required, nor is there any restriction on material. All other installations must conform. For example, a Navy shore-coaling station must be built within restrictions of Order L-193, but even though cost is over $5000, it does not have to be authorized on PD-681. On the other hand, a Navy-owned and operated collier with self-unloading equipment is free of both authorization and materials restrictions.

Privately owned ore carriers, fishing boats and bulk-material barges are fully under order L-193, but if its restrictions are impracticable, a waiver will undoubtedly be granted.

As previously stated, manufacturer or contractor is barred from submitting a definite proposition unless the purchaser has done his part, but the latter has at least a moral responsibility not to ask for a definite bid until his request on form PD-681 has secured necessary authorization. He does not incur any criminal liability by asking for a bid, but he does if he accepts it, and he may lead manufacturer or contractor into the embarrassing situation of unwittingly violating order L-193.

WPB's attitude has been fair and helpful toward requests for approvals and exceptions wherever they are justified. Decisions must, of course, be grounded in supply and demand for materials involved and requirements of the armed forces. It is of interest to know that Army and Navy cooperate fully with WPB, and often reshape specifications to conserve critical materials when not compelled to do so.

Huge Centrifugal Pumps Speed Oil Through "Big Inch" Pipeline

H P Binder, manager, centrifugal pump department, Allis-Chalmers Mfg Co, highlights the Big Inch oil pipeline, and then describes construction and operation of the 87 gigantic high-pressure centrifugal pumps that force oil through the line

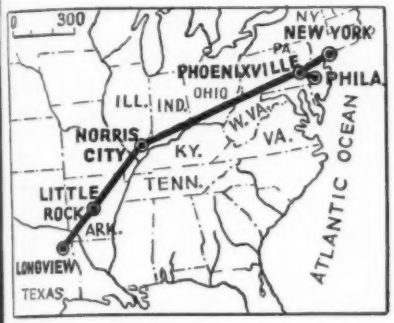


Fig. 1—Route of Big Inch from Longview, Texas to New York and Philadelphia, a distance of 1370 miles

▶ Big Inch, the world's largest pipeline, and one of the longest, delivers 300,000 bbl of crude oil daily from the Texas fields to New York and Philadelphia, to help relieve the East Coast's acute gasoline and fuel-oil shortage. Handling this oil requires 87 huge motor-driven centrifugal pumps, all operated in series to produce a combined head of nearly 55,000 ft. Before describing the pumps and their power units, let's review the project briefly.

Careful analysis showed that this war-emergency project would deliver 60% more oil per ton of construction steel than either tank cars or tankers and barges. As shown on the map, Fig. 1, the line extends from Texas to the East Coast, a distance of 1370 miles. It was built by the War Emergency Pipelines, Inc, organized by the Defense Plant Corp and financed by the Reconstruction Finance Corp, at a cost of about $95,000,000 to Uncle Sam. A number of leading oil companies provided the experienced personnel to design, build and operate the line.

In June, 1942, the War Production Board allocated 137,500 tons of steel for construction of the first division from Longview, Tex., to Norris City, Ill., a distance of 531 miles. Oil started to flow through the completed line a little over seven months later.

In October, 1942, over 300,000 more tons of steel were allocated to extend the line to the Atlantic seaboard. The second division went into service in July of this year.

Pipe is 24-in. outside diameter, built of 3/8-in. steel, made in 40-ft. lengths, which were welded on the job. The bulk of the pipe was supplied by the National Tube Co. It was given a special painting and spirally wrapped with two layers of asbestos felt before being buried to a depth of about 2 ft in a 4-ft ditch. Starting at an altitude of 350 ft above sea level in Texas the line reaches a maximum altitude of 2900 ft when crossing the mountains in Pennsylvania. From Phoenixville, Pa., one line of 20-in. pipe runs to New York and another to Philadelphia.

To fill the pipeline requires 4,000,000 bbl of oil. At a flow of 300,000 bbl per day it takes nearly 14 days for the oil, after entering the pipe at Longview, Tex., to reach New York and Philadelphia. This flow rate is about 100 miles per day (6 ft per sec).

Between Longview and Phoenixville, oil is pumped through the 24-in. line by 24 pumping stations, about 50 miles apart. In each station, three pumps are

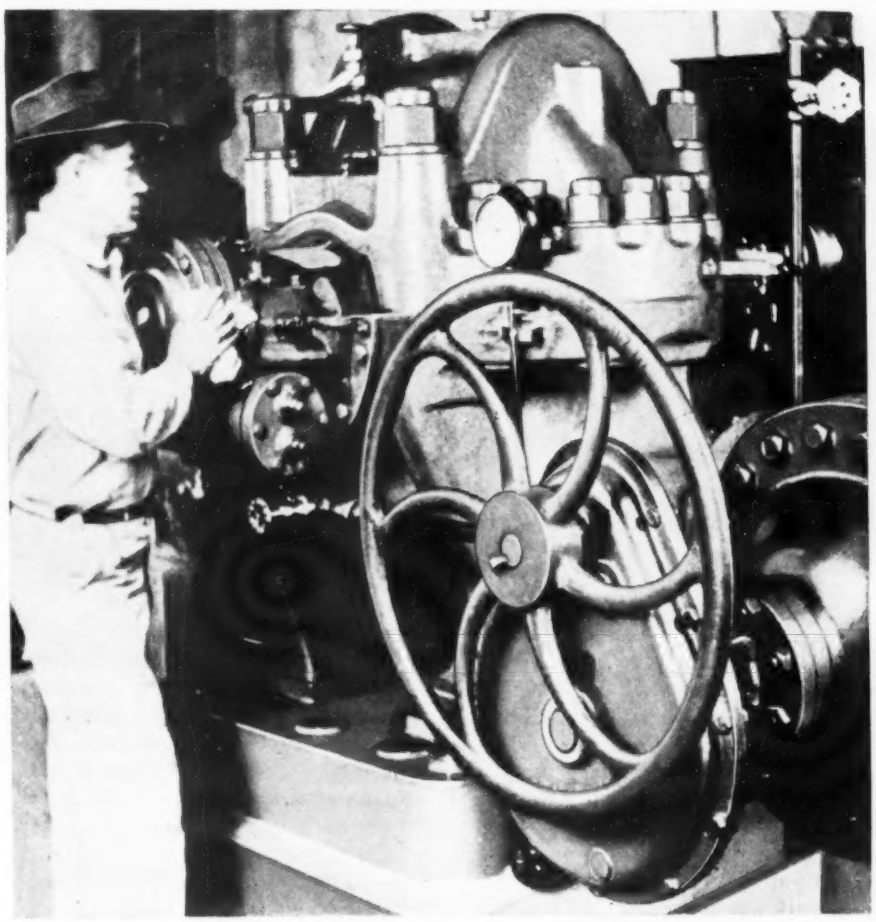
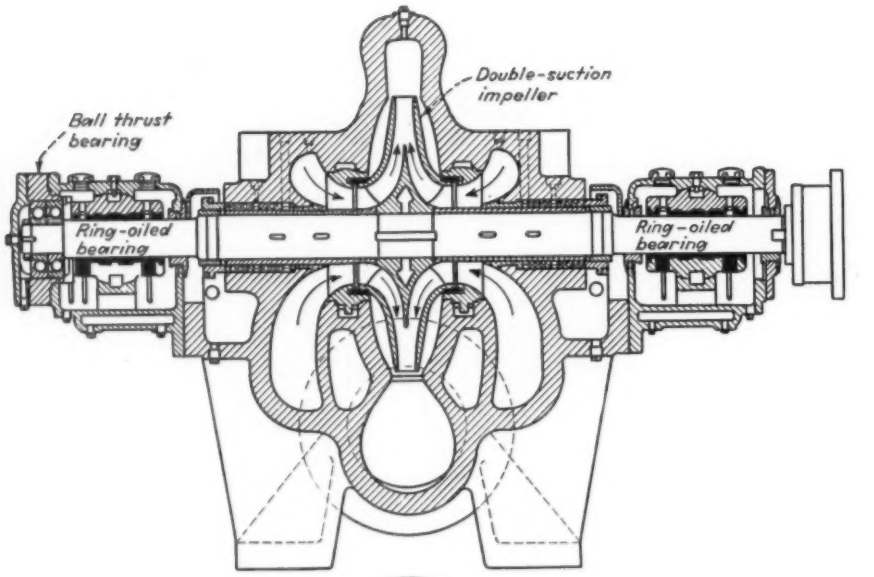


Fig. 2—Rated 8750 gpm at 630-ft head, three pumps like this one, in each of 26 pumping plants, speed 300,000 bbl per day through Big Inch pipeline



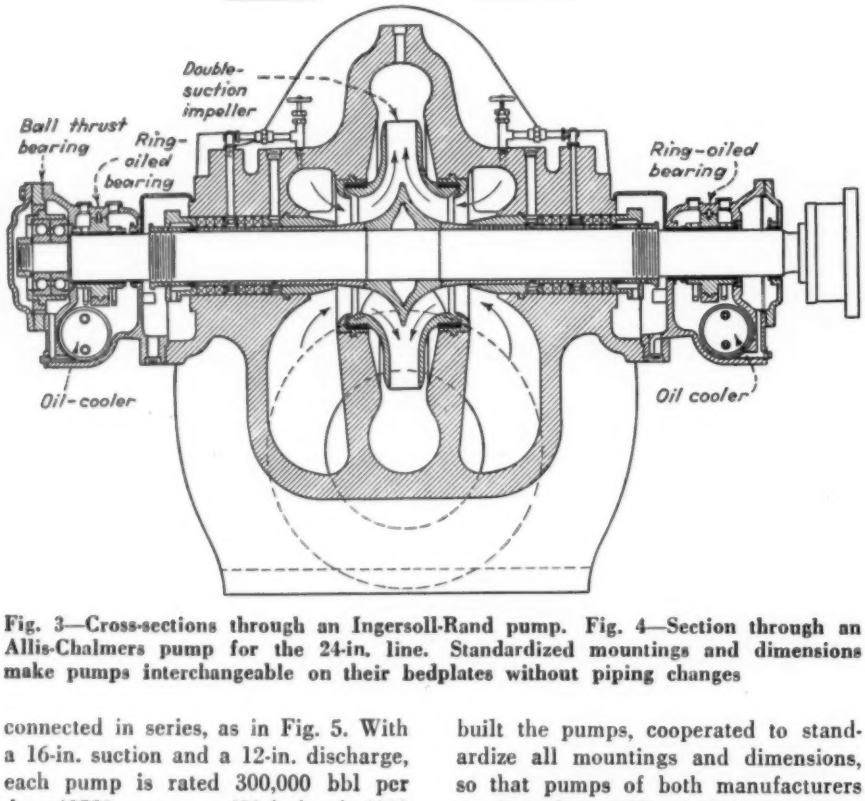


Fig. 3—Cross-sections through an Ingersoll-Rand pump. Fig. 4—Section through an Allis-Chalmers pump for the 24-in. line. Standardized mountings and dimensions make pumps interchangeable on their bedplates without piping changes

connected in series, as in Fig. 5. With a 16-in. suction and a 12-in. discharge, each pump is rated 300,000 bbl per day (8750 gpm, at 630-ft head (230 psi), when pumping 0.84-specific gravity 60 SSU crude oil. This makes the total net pressure developed by each station equal to 690 psi. With 50 miles between stations, pressure drop in the pipeline is 13.75 psi per mile. Oscar Wolfe, chief engineer of the line, says operation shows that actual line losses follow estimates closely.

Pumps develop a combined head of over 20,000 psi, or 55,000 ft. Operated in parallel, they would have a combined capacity of 640,000 gpm, or 9 billion gal per day. A 1500-hp 1780-rpm squirrel-cage motor drives each pump on the 24-in. line. Allis-Chalmers Mfg Co and Ingersoll-Rand Co, who built the pumps, cooperated to standardize all mountings and dimensions, so that pumps of both manufacturers are interchangeable on their bedplates, without piping changes. Details of design, however, are individual with each company, and spare rotating elements are not interchangeable.

Several reasons entered into the decision to use three single-stage pumps connected in series instead of several smaller multi-stage ones in parallel: Higher over-all operating efficiency can be maintained, especially as the line will operate at nearly 100% load factor. First cost was materially lower and, most important, pumps could be delivered on the job and installed to coincide with completion of pipeline.

A speed of 1800 rpm was selected as it gives high efficiency at reasonably specific speed and permits using the lower-priced standard-motor design. It also affords better shaft speed for the packing on the large-diameter shaft required.

Pump casings are made of high-tensile-strength cast iron, ribbed and bolted for 1200-psi test pressure. To save critical material, War Production Board insisted on impellers of cast iron instead of bronze. On account of the high stresses involved, high-test iron that would produce sound castings was selected with special care. They were given special heat treating to relieve strains.

Because of the high-suction pressures that stuffing boxes of the second and third pumps in the series combination normally have, a long-pressure reducing bushing with a leak-off connection, piped to the suction main, permits operation with about 50 psi on packing of all three pumps, see Fig. 3 and 4. Power loss from leakage is probably no more than the extra stuffing-box friction would cause with high pressure on the packing, and packing and shaft-sleeve maintenance is considerably less. Deep stuffing boxes seal the shafts.

Shaft Sleeves

Stuffing-box shaft bushings and casing wearing rings are made of bearing bronze, shaft sleeves and runner wearing rings of hardened stainless steel. These materials run well together without galling and give reasonably long life. Amount of really critical material is kept to a minimum.

Bearings at each end of the pumps have split, babbitted shells arranged for ring oiling and liquid cooling. A double-row ball thrust bearing is provided on the outboard shaft end. Fast-type couplings, with taper fits on the pump shaft, are identical for both makes of pumps.

General Electric and Westinghouse built the 1500-hp 1780-rpm 2300-v 3-phase 60-cycle squirrel-cage motors driving the main pumps. These motors are interchangeable as complete units as they are designed with the same base-rail mountings and shaft dimensions. The firewall stuffing box is on the motorshaft extension so that the rotating elements of the horizontal split-casing pumps can be lifted vertically by disconnecting the coupling without disturbing the motor setting. Even though the motors are standard open design, their frames permit discharging the ventilating air from their tops so that it can be piped through the firewall near the roof with suitable flame arresters.

Metalclad-switchgear motor control at each station consists of one 1200-amp incoming-line oil switch for the

Big Inch Highlights

Largest oil pipline and one of the longest in the world

Pipe: 24-in. outside diameter, steel, ⅜-in. thick, all welded, good for working pressure of 1000 psi, 1370 miles long.

Construction required nearly 450,000 tons of steel; cost is $95,000,000—U. S. Government financed

Capacity 300,000 bbl per day—12,600,000 gal

To fill the line, 4,000,000 bbl—170,000,000 gal—were required

Rate of flow in pipe, 100 miles per day (6 ft per sec), takes nearly 14 days for oil to reach seacoast after leaving Texas

Eighty-seven high-pressure single-stage centrifugal pumps operate in series, usually installed in groups of three in stations, to force oil through the pipeline

Pumps develop a combined head of over 20,000 psi and require 120,000 hp of motors to drive them

station and a 600-amp starting oil switch for each 1500-hp motor. All control equipment was wired at the factory as a complete assembly, and the compact design simplified the amount of field construction work and saved copper. All power switches are electrically operated 2300-v oil circuit breakers. Main breakers have an interrupting capacity of 100,000 kva and are interlocked for successive starting of motors.

In accordance with power-system requirements, 14 of the 26 stations use reduced-voltage starting equipment and the remaining 12, full-voltage. As reduced-voltage control costs almost twice as much as full-voltage, the latter is used wherever possible. Starting on full voltage, power inrush is about 500%, and on 65% of full voltage, about 210% full-load current. Individual motors are controlled by explosion-proof pushbutton stations, in both motor and pump rooms.

For automatic protection, mercoid pressure switches function at abnormally low or high pressures. If station inlet pressure drops to 35 psi, an alarm system operates. At 15-psi minimum, the main motors are shut down successively at 2-sec intervals by timing relays, stopping of the pump motors being automatically arrested if the pressure recovers before all motors in a station are disconnected. An operator must restart motors that have stopped because starting is not automatic. Pressure regulators also shut down motors, if station pressure builds up to 800 psi, and prevent restarting until pressure drops below 750 psi. Such protection is needed on booster units in a practically closed pipe system of this type.

Fourteen different power companies furnish power for the complete line. Depending on the system, primary voltage ranges from 110,000, 66,000, 33,000 to 22,000 v. It is stepped down to 2300 v through a single 3-phase 3750-kva outdoor transformer at each station.

A total of 208 power-line miles had to be constructed. Longest line is about 57 miles in length and supplies the station on the Arkansas-Missouri state line. A total of 90,000-kva of transformer capacity is required for the 120,000 hp of motors, which consume about 800,000 kwhr per year to move 300,000 bbl of oil through the line daily.

Steel Power Conductors

Because of the critical copper situation, WPB insisted on steel conductors for the transmission lines. The engineers had very few precedents as a guide in their specifications for the large power requirements for this type of line. For the first twelve stations, ½-in. 7-strand high-strength extra - galvanized - steel wire has been installed.

At each station, the incoming 24-in. pipeline ends in a scraper outlet box and the outgoing line has a similar intake box, Fig. 5. Each box is controlled by a 24-in. gate valve and a kicker connection to the high-pressure side of the station to force the plug out of or into the line as desired. Each of the incoming and outgoing lines has a 24-in. control valve also. Between scraper box and control valves, an 18-in. loop line, with a gate and a check valve, connects the two ends of the 24-in. line to serve as a bypass around the pumping station, as in Fig. 5.

An 18-in. station loop, with strainer and control gate valve, leads from the

(*Continued on page* 142)

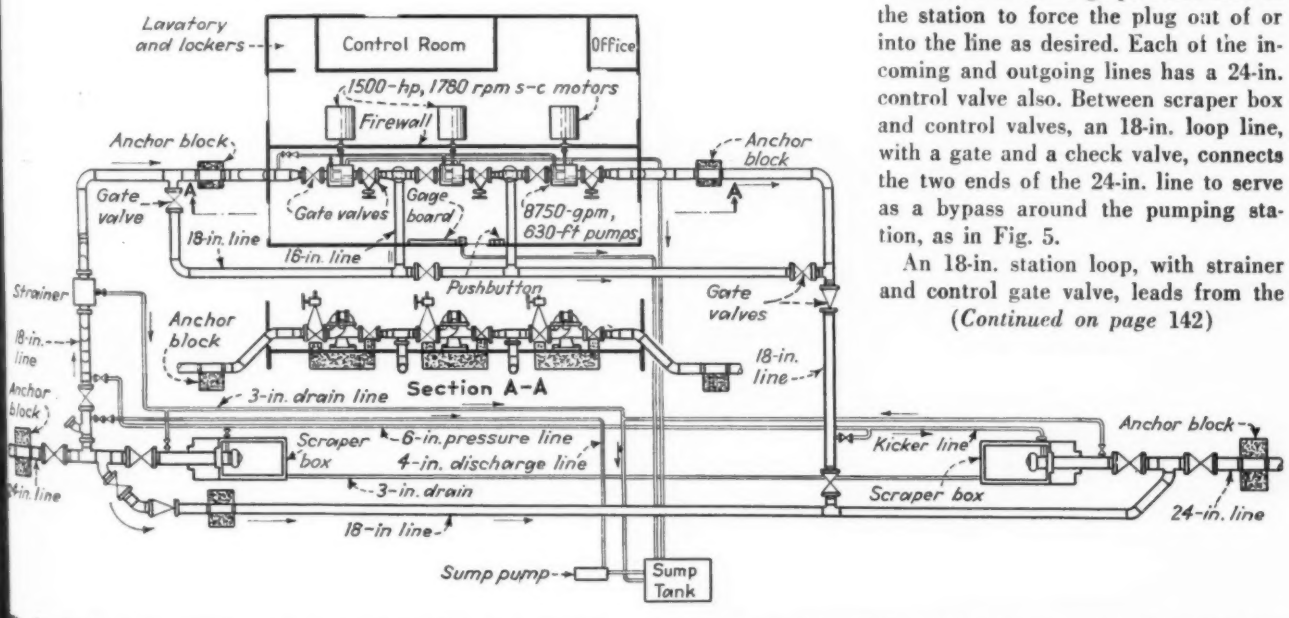


Fig. 5—Piping for pumping station on 24-in. line. Pumps are set side by side so flow is straight through them when all three operate in series. Piping and valve arrangement permits any one or two to operate individually or in series in emergency

A Short Cut to Turbine Cycle Heat Rates—

► BY DEFINITION a turbine cycle heat rate is the net heat supplied to the turbine cycle per unit of power taken out, that is, the heat into the cycle minus the heat returned to the boiler, per kwhr of electrical output. Referring to Fig. 1, the net heat rate is the heat supplied per hour at *A* to the turbine room minus the heat returned per hour at *B* to the boiler room when the output is 1 kw.

Heat is going out of the boiler room at only one point, *A* (neglecting boiler loss). Heat flows into and out of the turbine cycle system at the right. Heat is coming in at point *A* and going out at the following places: (1) generator terminals, *P*; (2) bearings and generator air coolers, *L*; (3) cooling water, *C*; (4) feedwater returned to boiler, *B*.

We have defined the heat rate under the conditions for which the energy output is 1 kwhr as the "net heat in"—the heat at *A* minus the heat at *B*. Since energy cannot be destroyed the total quantity of energy out of the turbine cycle must equal the total quantity of energy going in. It is apparent that the heat rate must, therefore, be the heat represented by the 1 kwhr of energy output, plus the heat loss due to bearing friction and generator loss, plus the heat rejected in the cooling water:

Heat rate = 3413 + Btu/kwhr in generator and bearing losses + Btu/kwhr rejected to cooling water

The first of the above items, the energy output, may be fixed at 1 kwhr. The second item, bearing and generator loss, usually is not subject to the power plant designer's control. The third item, heat rejected to the cooling water, is, however, subject to control by the heat balance engineer. This item is the prime determinant of heat rate in a given cycle.

Let it be emphasized that no matter what happens within the turbine cycle, the heat rate is unchanged except insofar as changes within the cycle affect the heat rejection to the cooling water per kwhr of output. Regardless of the number of heaters, terminal differences, pressure drop, flashing losses, etc, heat rate is affected only in proportion to the resulting effect of these various items on the heat rejected to the cooling water per kwhr. Any change in the heater system inescapably changes the heat rejected to the cooling water, consequently the heat rate, the other two items for present purposes being fixed. This viewpoint is especially fruitful in heat balance work because it focuses attention on one unknown, eliminating a large number of troublesome variables.

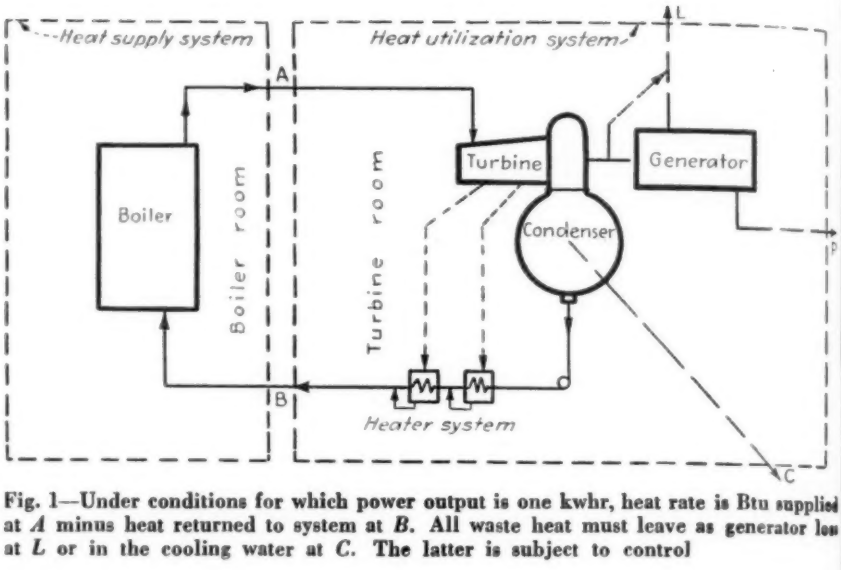


Fig. 1—Under conditions for which power output is one kwhr, heat rate is Btu supplied at *A* minus heat returned to system at *B*. All waste heat must leave as generator loss at *L* or in the cooling water at *C*. The latter is subject to control

For given steam conditions and rating the exhaust heat content of a turbine depends chiefly on the throttle flow, although exhaust flow has a biasing effect which can be taken care of separately. At constant throttle flow the heat rejected in the condenser *per pound of condenser flow* is thus definitely fixed, neglecting the effect of exhaust flow on exhaust heat content. The problem resolves itself into finding the lb per hr flow to the condenser.

Finding Condenser Flow

Since all flow going into the turbine must come out either at the exhaust or at the extraction openings, the condenser flow may be found by subtracting the flow taken out at the bleed points from the throttle flow. The vital and *only* question then becomes: How much steam is extracted for feedwater heating per kwhr? (Not what stage did it come from? What was its heat content? What was the heater arrangement? But *how much* was extracted?) In every case the answer to this question tells us the heat rate, with a little additional analysis, and conversely, as will be shown later, if we know the heat rate we may find the amount extracted.

The more steam that can be extracted per kwhr output, the lower the heat rate becomes. Raising feedwater temperature is a good way to increase the extraction but unfortunately sooner or later, with a finite number of heaters, the pounds extracted per kwhr begin to decrease, resulting in an increase in the cycle heat rate. There is, therefore, for any cycle, a best feedwater temperature—a temperature which gives the best possible heat rate based on purely thermodynamic considerations.

The most fundamental concept of formal thermodynamics is that of "reversibility" which says that any thermodynamic process to be most efficient should take place in small steps—steps so small that heat transfer requires an infinitesimal temperature difference. If these conditions are fulfilled, the process can then be reversed, that is, it can take place in the opposite direction without external help since the heat is never required to flow from a lower to a higher level of temperature. To fulfill the conditions in a feedwater heating cycle it is necessary only that we cause the temperature differences between steam and incoming water to approach zero, as it does, for example, in the lowest heater when the duty decreases at light loads.

The principle of reversibility leads us to the obvious conclusion that a cycle with an infinite number of feedwater heaters, each one heating the feedwater an infinitesimal amount, has the *best possible* heat rate. This cycle is still not a reversible cycle and cannot be, where superheated steam is extracted, or when a finite number of heaters is used, because of the necessary temperature difference between the extracted steam and the water entering the heater.

Although such a cycle is impossible of achievement, the determination of the heat rate for the cycle is not impossible.

By J KENNETH SALISBURY
General Electric Co

Quick and accurate method for determining improvement in heat rate from feedwater heating for any steam conditions

Heat rates may be found for a cycle with an infinite number of heaters with mathematical exactness*, using the approach discussed above, in which only the condenser flow is calculated.

The heat rate using an infinite number of heaters is found to be much lower than the heat rate of the same plant with no feedwater heating whatsoever. Such heat rates are lower by the percentages shown in Fig. 2. The ordinates of Fig. 2 are the gains over a non-extraction plant resulting from heating the feedwater in an infinite number of heaters to the maximum possible final feedwater temperature. This maximum temperature is the boiler drum temperature if we assume that the drum pressure is equal to the turbine throttle pressure.

* "The Steam Turbine Regenerative Cycle —An Analytical Approach", by J. Kenneth Salisbury, *ASME Transactions*, April, 1942.

Since actually there is a considerable pressure drop between the drum and the turbine, the enthalpy to which the feedwater is heated under the conditions of Fig. 2 is the "saturated liquid enthalpy corresponding to the throttle pressure." The *rise* in enthalpy between the condenser hotwell and the saturated liquid enthalpy corresponding to throttle pressure is then called *possible rise*.

Actual Cycles

All feedwater heating cycles approach to a greater or lesser degree the standard of perfection described by the cycle with an infinite number of heaters. Since all cycles gain less than the values shown in Fig. 2, the true gain of an actual cycle over the non-extraction heat rate is then the product of the theoretical gain and the realizable fraction of this gain.

The realizable fraction of the gain has been found by many calculations for widely varying conditions to be as shown in Fig. 3 in which the various curves each represent number of heaters. It so happens that the values are practically independent of initial steam conditions provided they are plotted against fraction of "possible rise." From the curves in Fig. 3 may be derived curves which show the optimum feedwater temperature against number of heaters for various initial pressures. This is done by evaluating the abscissa of Fig. 3 at the peaks of the various curves, for typical steam pressures, and converting to feedwater temperature instead of enthalpy rise. The results are shown in Fig. 4, together with horizontal lines indicating the theoretical top extraction pressure required to attain the temperatures shown as ordinates.

Finding Heat Rates

In order to find the heat rate of any turbine and heater cycle Fig. 2 and 3 are used together. On Fig. 2 at the proper steam conditions read the gain over non-extraction heat rate which would be obtained in a cycle with an infinite number of heaters. Then find the value of the fraction:

$$\text{Percentage of possible rise} = \frac{h_{feedwater} - h_{condenser\ hotwell}}{h_{throttle\ pressure} - h_{condenser\ hotwell}} \times 100$$

At this value of the abscissa on Fig. 3 and on the proper curve, the ordinate found is the percent of the theoretical gain (Fig. 2) that can actually be realized.

The heat rate found by applying this gain to the non-extraction heat rate is for a cycle in which all of the heaters have zero terminal differences and in which there is no pressure drop between the turbine and the heaters. It further assumes that the efficiency of the turbine does not change when steam is extracted for feedwater heating. Since neither assumption is exactly true, corrections must be applied.

In most cases the correction for cycle losses such as terminal differences, pressure drop, etc, are about 0.5 to 1% in heat rate and the uncorrected heat rate found by the method described must be *increased* by this amount for an average cycle.

The change in turbine efficiency is due primarily to reduction in congestion in the exhaust when steam is extracted. The greater the congestion when operating non-extraction, the greater will be the gain in efficiency

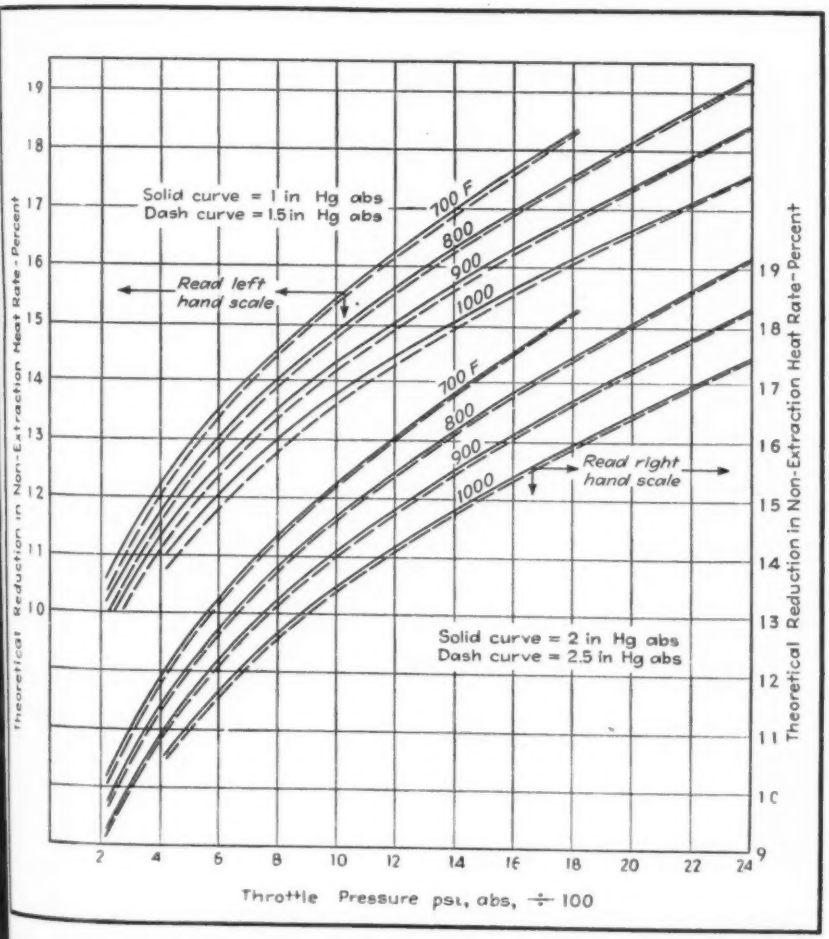


Fig. 2—Theoretically possible reduction in non-extraction heat rates accomplished by an infinite number of contact heaters raising feedwater enthalpy from that corresponding to exhaust pressure to saturation enthalpy corresponding to throttle pressure. Based on 80% turbine efficiency: for each 5 points increase in turbine efficiency values increase by approximately 0.1

Table I

THEORETICAL NON-EXTRACTION HEAT RATES, BTU PER KWHR

Initial press, psi g	Initial temp, F	Back pressures, in. Hg 1	1.5	2	2.5
200	650	10140	10528	10840	11094
	700	10031	10405	10704	10953
	750	9919	10280	10568	10812
	800	9804	10153	10432	10670
	850	9686	10023	10296	10528
	900	9565	9891	10160	10386
300	650	9681	10009	10279	10502
	700	9581	9907	10167	10383
	750	9481	9801	10053	10261
	800	9380	9692	9937	10137
	850	9280	9580	9819	10011
	900	9179	9466	9699	9883
400	650	9371	9677	9923	10110
	700	9284	9583	9822	10006
	750	9195	9487	9719	9900
	800	9105	9389	9613	9792
	850	9013	9289	9505	9682
	900	8919	9186	9396	9570
	950	8823	9081	9284	9456
600	650	8995	9261	9465	9646
	700	8914	9175	9377	9549
	750	8832	9087	9287	9451
	800	8750	8998	9194	9352
	850	8667	8907	9098	9252
	900	8583	8816	9001	9151
	950	8498	8725	8902	9050
	1000	8411	8633	8801	8949
800	650	8757	8992	9184	9341
	700	8679	8913	9099	9251
	750	8601	8832	9013	9161
	800	8522	8749	8925	9070
	850	8443	8665	8837	8978
	900	8364	8580	8749	8886
	950	8284	8495	8658	8792
	1000	8204	8409	8566	8697
1000	700	8513	8730	8898	9043
	750	8436	8651	8817	8951
	800	8360	8571	8735	8871
	850	8284	8491	8651	8784
	900	8208	8411	8567	8697
	950	8132	8330	8483	8609
	1000	8056	8248	8398	8521
1200	750	8314	8516	8675	8808
	800	8240	8438	8593	8723
	850	8165	8360	8511	8638
	900	8090	8282	8429	8553
	950	8015	8203	8347	8468
	1000	7939	8124	8265	8383
1800	850	7929	8102	8238	8349
	900	7855	8025	8157	8266
	950	7781	7948	8076	8183
	1000	7707	7871	7995	8100
2400	850	7797	7952	8076	8180
	900	7720	7875	7996	8098
	950	7646	7799	7917	8017
	1000	7565	7724	7839	7937

NOTE: Table derived from "Theoretical Steam Rate Tables," by J H Keenan and F G Keyes, ASME, New York, N. Y., 1938.

The values obtained from the tables have been altered slightly in a few cases to give smooth curves.

Divide by the over-all turbine-generator efficiency to obtain the non-extraction heat rate.

for a given percentage of the throttle flow extracted for feedwater heating. The net result of the change in turbine efficiency resulting from extraction is a reduction of the heat rate of 1–2½% at full load.

Of course the gain is also determined to some extent by the quantity of steam extracted for feedwater heating (which depends primarily on the feedwater temperature) but the above values are for typical cycles with normal feedwater temperatures. For the present purpose a "congested exhaust" may be considered as one which has an exhaust flow of more than 6000 lb per hr per sq ft of last stage projected area. Exhausts of this kind show gains approaching the higher value of 2½%. Exhausts having less condenser flow show gains which approach the lower figure of 1%.

Many times an accurate calculation of the heat rate is not important to the user of this method. He may be willing to sacrifice accuracy in the interest of speed. Although accuracy is obtainable by taking into account all of the known facts, as will be demonstrated later, a first approximation of the heat rate is readily obtainable by using the curves thus far presented. If the user exercises judgment in applying the corrections for exhaust loss and cycle, the result should easily be accurate to within 1% or less. The following example illustrates this application.

Find the heat rate of a machine rated 35,000 kw with steam conditions of 1200 psi, gage, 900 F, 1-in. Hg abs. Assume that four heaters are used to heat the feedwater to 400 F, and that the non-extraction water rate at 35,000 kw is given as 7.6 lb per kwhr.

To enter Fig. 3 find the value of x:

$h_{feedwater} - h_{condenser} = 375 - 47 = 328$

$h_{saturation} - h_{condenser} = 573.8 - 47 = 526.8$

$$x = \frac{328}{526.8} = 0.622$$

P (from Fig. 3) = 0.74

G (from Fig. 2) = 0.151

$PG = 0.74 \times 0.151 = 11.18\%$

Non-extraction heat rate = Non-extraction water rate $(h_{initial} - h_{feedwell}) = 7.6\ (1440.2 - 47) = 10{,}585$ Btu per kwhr.

Uncorrected heat rate = 10,585 (1 − 0.1118)	=	9405
Add 1% (estimated) for cycle	+	94
Heat rate corrected for cycle		9499
Subtract 2% (estimated) for reduction in exhaust loss	−	190
Approximate heat rate, Btu per kwhr.		9309

Note that the cycle correction and exhaust loss correction tend to offset each other and that an alternative is to lump these two corrections giving a net improvement over the uncorrected heat rate of approximately 1% for estimating purposes:

9405 (1 − 0.01) = 9311 Btu per kwhr

To obtain the output of the unit during bleeding operation, the throttle water rate may be found and divided into the original throttle flow. Since

Heat rate = Extraction water rate $\times (H_{initial} - h_{feedwater})$

$$\text{Extraction water rate} = \frac{\text{Heat rate}}{(H_{initial} - h_{feedwater})}$$

that is

$$\text{Extraction water rate} = \frac{9309}{1440.2 - 375} =$$

8.74 lb per kwhr.

The ratio of the extraction output to the non-extraction output, for constant throttle flow is equal to the quotient of the respective water rates, hence, if the non-extraction output was 35,000 kw, the extraction output is

$$35{,}000 \times \frac{7.6}{8.74} = 30{,}430 \text{ kw.}$$

Theoretical Heat Rates

For convenience in calculation, Table I shows "theoretical non-extraction heat rates" for various initial steam conditions at four different exhaust pressures. They are "theoretical" in that they are based on the Rankine cycle, that is, they are for turbines having 100% efficiency.

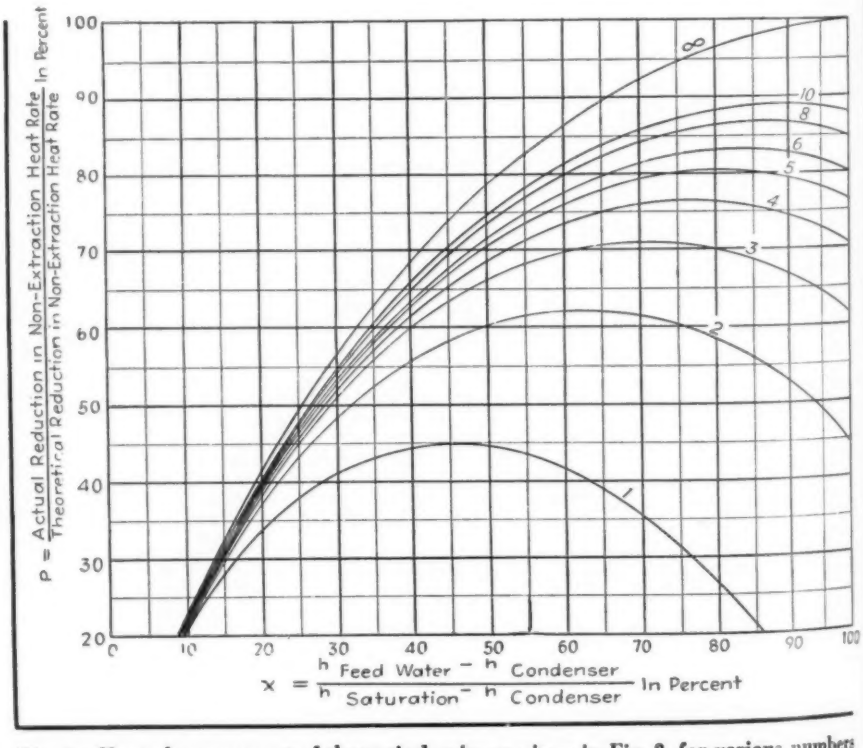


Fig. 3—Chart shows percent of theoretical gain, as given in Fig. 2, for various numbers of heaters plotted against percent of "possible" rise

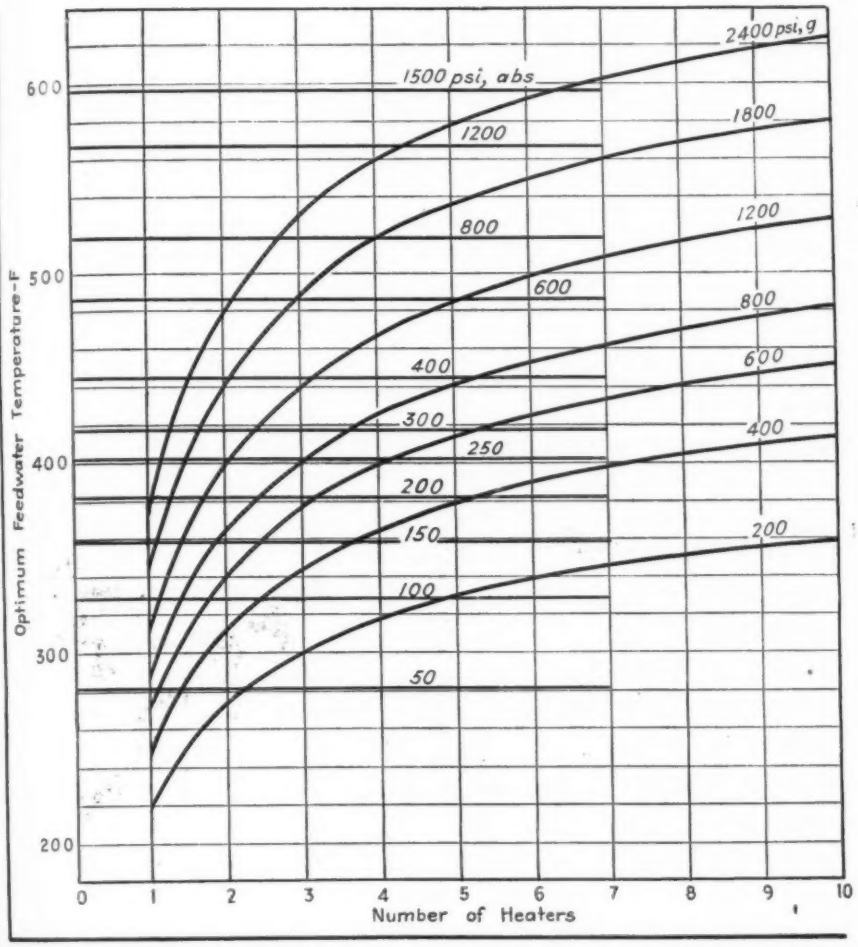


Fig. 4—Theoretical optimum feed temperature for various numbers of heaters and 1-in. Hg condenser pressure. Figures on curves are throttle pressure in psi gage. Horizontal lines indicate theoretical top extraction pressure in psi absolute with no heater terminal difference and no pressure drop. To obtain true stage pressure, add about 10% to values shown

To construct these tables the theoretical steam rates* are multiplied by the initial heat, H_s, minus the saturated liquid enthalpy at the exhaust pressure, h_e.

Since the actual non-extraction steam rate is equal to the theoretical water rate divided by the over-all turbine-generator efficiency, the actual non-extraction heat rate may be obtained by dividing the value chosen from Table I by the over-all turbine-generator efficiency.

Field of Application

For a complete knowledge of any feedwater heating cycle only detailed calculation can provide all of the necessary data. The present method is useful where the resulting heat rate and other information, not involving individual heater data, is required. Obviously it will not provide such data as the heater pressures, heater duties, etc. Nor will it tell the exact amount of steam extracted at each individual opening of the turbine. The method will, however, as is later demonstrated, tell with accuracy the *total* amount of steam extracted, the reduction in output accompanying this extraction, the throttle water rate with extraction, condenser duty, etc.

One of the most common variations of actual cycles from the assumptions used in this analysis lies in the distribution of duty among the various heaters, which is dependent on the extraction stages that are chosen. Usually a choice of several extraction stages is offered by the turbine manufacturer for each opening on the turbine shell. It is desirable to make the rise in enthalpy in each of the heaters approximately equal to the average rise per heater. This analysis assumes exactly equal enthalpy rises in each heater.

This distribution has been proved to give the best possible heat rate for the special case of zero pressure drop and zero terminal difference, and undoubtedly is a close approximation of the best arrangement for an actual cycle with pressure drop and terminal difference other than zero. Losses which result from a departure from the "equal rise" distribution are negligible for small inequalities of the rises per heater, but increase more and more rapidly as the distribution becomes poorer and poorer, that is, as the heaters depart more and more from the average rise.

State-Line End Point

The usefulness of this method may be greatly expanded by making a few additional simple calculations to obtain a value known as the "state-line end point," which usually is not provided in non-extraction guarantee data. It is customary in extraction calculations to regard the efficiency of the turbine as depending only on the throttle flow except for a slight modification which results from changes in the efficiency of the last stage. This viewpoint is adequately supported by test.

The turbine efficiency as a whole changes, however, because, as steam is extracted, there is a reduction in the kinetic energy in the exhaust as well as in the potential energy associated with the pressure drop in the exhaust hood. Convenience, as well as accuracy, then dictates that the constant part of the efficiency be used to obtain the state lines used in extraction calculations, and that the exhaust loss be applied only after the true flow to the exhaust (which determines the efficiency of the exhaust end) is known. The constant efficiency is known as the *internal efficiency*, whereas the poorer efficiency obtained after application of the exhaust loss is known as the *wheel efficiency*. The internal used energy is the energy in Btu converted to useful output, before the exhaust loss is sustained. When subtracted from the initial enthalpy, H_s, the state-line end point results.**

When all of the losses which are included in a turbine non-extraction water rates are known, the state-line end point can be calculated. The elements which are included in a non-extraction water rate are: (1) internal efficiency including gland loss, (2) exhaust loss, (3) generator efficiency, and (4) fixed or mechanical loss (bearings, water seal).

To obtain the state-line end point the following formulas then apply:

(1) $$U = \frac{3413}{\text{Non-extraction water rate} \times (ME) \times \left(1 - \frac{EL}{AE}\right)}$$

(2) $$H_e = H_s - U$$

where:

U = Used energy with zero exhaust loss, Btu per lb

(*Continued on page* 144)

* *Theoretical Steam Rate Tables*, by J H Keenan and F G Keyes, ASME, 1938

** This includes the effect of gland leakage loss, which results from bypassing steam from the first stage shell to one or more lower stages—hence is properly chargeable to the internal efficiency.

TO PREVENT FIRE
Keep Your Plant Shipshape

Just because you have never had a fire, don't figure that you have little to fear from one. Here are some tips from the Safety Research Institute staff that you can use during Fire Prevention Week, October 3–9, and every week thereafter

► FIRE PREVENTION BEGINS with good housekeeping. Carried into every nook and corner of the plant, it lays the groundwork for an effective fire-prevention program. Remember, immaculately kept boiler and engine rooms sometimes result in material being stored haphazardly in unfrequented corners and stair wells. These out-of-sight out-of-mind paint cans, oily rags and wood debris form a good combination to set off the fireworks.

Suppose, for instance, someone lays a few boards in an out-of-the-way corner, and innocently forms an inviting corner to throw wood scraps. Along comes another man with an assortment of junk; seeing what looks like a refuse pile, he adds his collection. The original orderly storage, lacking regular inspection, soon degenerates into a junk pile and fire hazard. Material worth harboring deserves storage in an orderly manner.

The plant fire chief directs the fire-prevention program and originates an inspection schedule, such as the one on the opposite page, which is condensed from a 4-page form, checks up on plant house cleaning, trains fire brigades and installs pertinent warning signs. The following pointers will solve such plant problems as material storage, waste disposal, cleaning and inspection:

Paper, rags and wood scraps. Burn combustibles, such as paper unless it is baled for resale, oily rags, waste and wood scraps or excelsior, preferably in an incinerator; outdoor burning should be a safe distance from buildings. A metal can fitted with a self-closing lid is a safe container for oil soaked rags until their daily burning. Metal bins protect clean rags and flammable packing material, such as excelsior.

Flammable Liquids and Paints. In open containers, chemicals, oils and other flammable liquids are dangerous. Provide safety cans holding only enough of them for one day's supply in the shop. Paint and lacquer cause bad fires. A serious hazard results from

If some careless person flicks a lighted cigaret stub into this debris, it's all set for a fine fire. Those oily rags also are likely to ignite spontaneously

HERE ARE NINE FIRE-PREVENTION POINTERS TO

1. Keep stock in sectionalized fire-resistant warehouses.
2. Install automatic protection in all unattended fire-hazard areas.
3. Space emergency buildings to prevent spread of fire.
4. Educate every individual in careful housekeeping, and control dangerous personal habits, such as smoking and careless handling of volatile solvents.
5. Make use of watchmen, alarm systems and central supervising stations.
6. Institute careful inspection practices suggested, both within the company and through outside agencies.

allowing paint coating to build up on spray-booth surfaces. Clean this equipment often and, to avoid accidental fires, use a non-sparking tool. Better still, coat the booth with a thin layer of soap or grease so paint and lacquer can be removed easily.

Ashes and coal dust. When boiler-room ashes are removed by hand, furnish metal containers, never wood or cardboard ones. Clean coal-dust accumulations from overhead beams and surfaces and, more important still, do so without stirring up enough air-borne dust to make an explosive mixture.

Access to fire extinguishers. Always pile or stack finished products, raw materials or processed parts so they won't block access to fire extinguishers or obstruct passage of firefighting equipment. Keep stacked material away from sprinkler heads so it will not interfere with water distribution.

Firefighting equipment. Establish adequate equipment, such as hose trucks or reels, first-aid extinguishers, axes, blankets and all-purpose gas masks at strategic locations throughout the plant and advertise their location prominently.

Automatic systems and first-aid extinguishers. Protect especially hazardous and unattended areas with automatic systems recommended for the particular material stored, and place individual first-aid extinguishers near equipment or processes most apt to catch fire. Remember that attendant must reach the extinguisher before he can fight a fire, so don't place it too near the machine to be protected. Mount extinguishers on the wall at least waist high and in a prominent place where material cannot hide them. Use paint to line off a small section of floor directly in front of the extinguishers. Make this area a no-man's land for storing material.

Selecting Extinguishers. Look over your fire-fighting equipment with a cold

(*Continued on page* 180)

T TO IMMEDIATE USE

7 Strengthen fire-fighting facilities by organizing fire brigades, providing first-aid fire appliances, and carefully training the firemen.

8 Develop alertness to all potential fire hazards.

9 Organize salvage work to minimize damage and loss and to reestablish production rapidly.

SUGGESTED FORM OF

SELF INSPECTION BLANK FOR INDUSTRIAL PLANTS

Prepared by The National Board of Fire Underwriters, 85 John Street, New York, as a daily report for plant owners to have printed in quantity for their individual use

Cleanliness and Order

1. Was your inspection complete, covering all parts of the premises, including looking under benches, into closets, behind radiators, elevator pits, etc?.....
2. Where did you find dirt or litter?.....
3. Were all clothes lockers clean and in good repair? .....
4. Where did you find oily waste or any other greasy material outside of approved waste cans? .....
5. Are any waste cans not emptied daily after closing hours?.....
6. What rooms or departments were not as clean as they should be?.....
7. Was yard free from combustible material? .....

Maintenance

8. Is there any part of the plant which the watchman fails to visit?.....
9. Are any watch-clock records unsatisfactory? .....
10. Where were machinery, belts or shafting in bad condition?.....
11. Where were bearings dirty or poorly oiled? .....
12. Were any aisles obstructed in stock room? .....
13. Where do piles of stock or other obstructions interfere with entering any part of building?.....

HAZARDS

Heating

14. Where was woodwork or other combustible material too near to smokestacks, flues, furnaces, boilers, steampipes, etc? .....
15. Where was anything placed to dry on boiler or steam pipes?.....
16. Was fuel supply safely arranged?....
17. Can heated irons be set upon combustible material? .....

Lighting and Electrical Equipment

18. Where were there any open flame lights near combustible material?.....
19. Where were there any broken fixtures or loosened wires?.....
20. Where were ordinary electric cords looped over nails or found in contact with anything?
21. Where were any fuses replaced by wire or otherwise defective?.....
22. Where did any panel boards or switch and fuse cabinets need cleaning?.....
23. Where did any motors need cleaning, outside or inside?.....
24. Where was there insufficient oil in any motor bearings? .....
25. In what manner was there any violation of our rules for storing or handling oils, gasoline or other inflammable liquids? .....
26. Where were any fan bearings inaccessible or poorly oiled?.....
27. Where were any screens or dampers in air ducts out of order?.....
28. Where did you find any other than safety matches? .....
29. Where did you find any violation of our rules on smoking?.....

PROTECTION

Fire Doors, Traps, Shutters and Escapes

30. Where were fire doors wedged open, obstructed or out of order?.....
31. Where were the automatic attachments of fire doors out of order?.....
32. Where were traps or doors on openings through floors out of order?.....
33. Are they ever left open when not in use? .....
34. Are fire doors or shutters ever left open at night, on Sundays or Holidays?..
35. Where were fire escapes obstructed, broken or out of order?.....

Alarm Valves

Location		Location	
A.....		C.....	
B.....		D.....	

	A	B	C	D
36. How was valve tested?				
37. Did any bells fail to ring?..				
38. Was valve left in order? ...				

AUTOMATIC SPRINKLERS

39. Where is stock piled within 24 inches of sprinkler heads?.....
40. Have any sprinklers operated since last inspection? .....
41. Where are any sprinklers coated or corroded? .....
42. Where are any sprinklers obstructed by partitions, joists, etc?.....
43. Where are any sprinklers bent?.....
44. Where are any sprinklers leaking?....
45. Where are any sprinklers exposed to freezing? .....
46. Where are any sprinklers missing?....
47. Where are any sprinklers disconnected? .....
48. How many sprinkler heads are kept in reserve? .....

I have made a careful inspection and to the best of my knowledge and belief the foregoing statements are all correct.

Date ..... (Signed) .....

FLOWMETERS
Measure Rapidly Fluctuating Flow

J B McMahon, engineer Republic Flow Meters Co, outlines the problems involved in measuring highly fluctuating flow and then describes a metering system for doing this successfully

► TWO KINDS of highly fluctuating flow are encountered in industrial flow measurements. Both are difficult to measure by head flowmeters, which utilize pressure drop through an orifice plate, flow nozzle or venturi throat as the measurement basis:

1. One kind, commonly called pulsating flow, occurs in lines serving reciprocating steam engines, compressors and pumps. To date, no generally satisfactory solution has been found to measure this kind of flow by head meters, and the ASME Fluid Meters Committee* is now investigating the matter.

2. The other type either has a lower frequency than pulsating flow, or is erratic in character, requiring a highly responsive meter to follow the fluctuations. Here, the main difficulty lies in interpretation and integration of flowmeter readings. This article discusses measurement of this kind of fluctuating flow. The three reasons why the ordinary flowmeter is not adapted to measuring this kind of flow are:

A. In most flowmeters, mercury must be transferred from one manometer chamber to another and in practically all designs, appreciable quantities of line fluid must be moved through the lead lines into and out of these chambers. If flow changes are sufficiently rapid, the ordinary meter does not respond to the full extent of the changes. Then, a record based on an average of differential pressure does not represent average flow. It would be repre-

* See "Developments in the Measuring of Pulsating Flows with Inferential Head Meters." S R Beitler, E J Lindhal and H B McNichols. Trans. ASME, May, 1943.

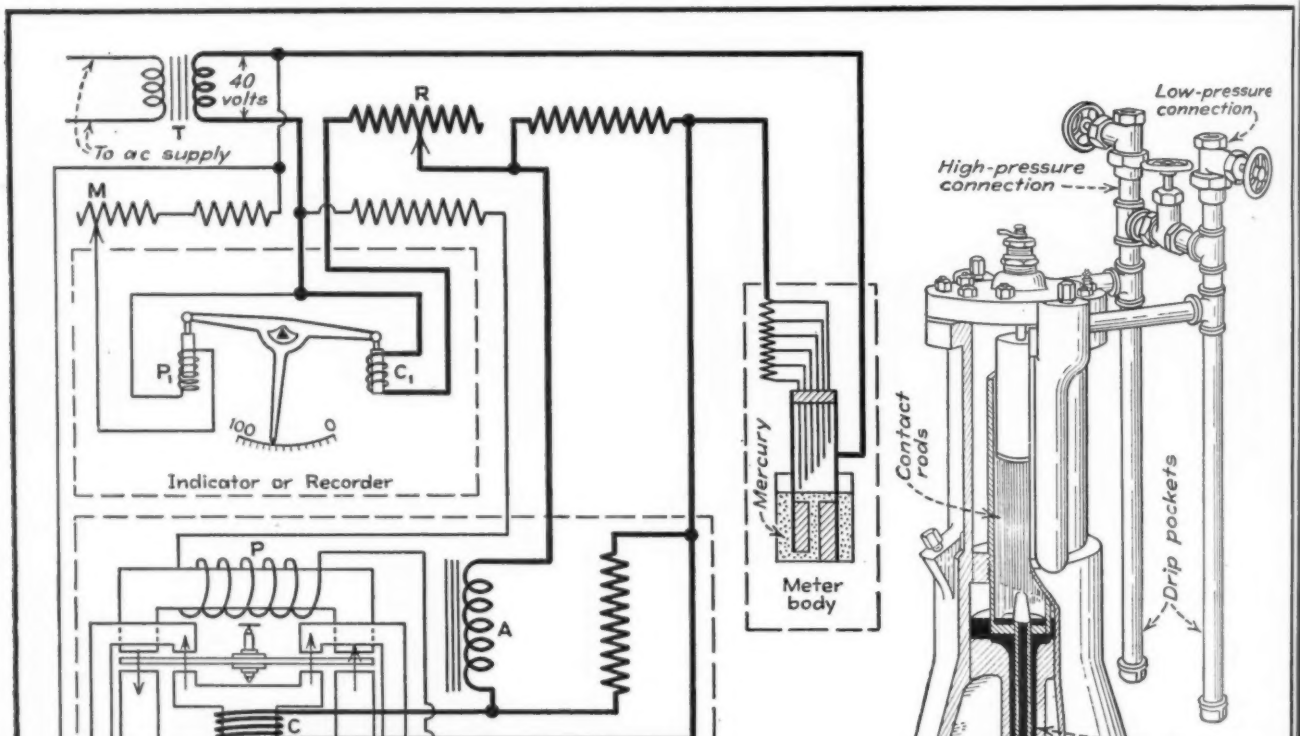


Fig. 1—Electrical flowmetering system with integrator designed on a watthour meter principle measures conductance of the current circuit to correctly measure fluctuating flow. Fig. 2—Section through meter body for electrical flowmetering system

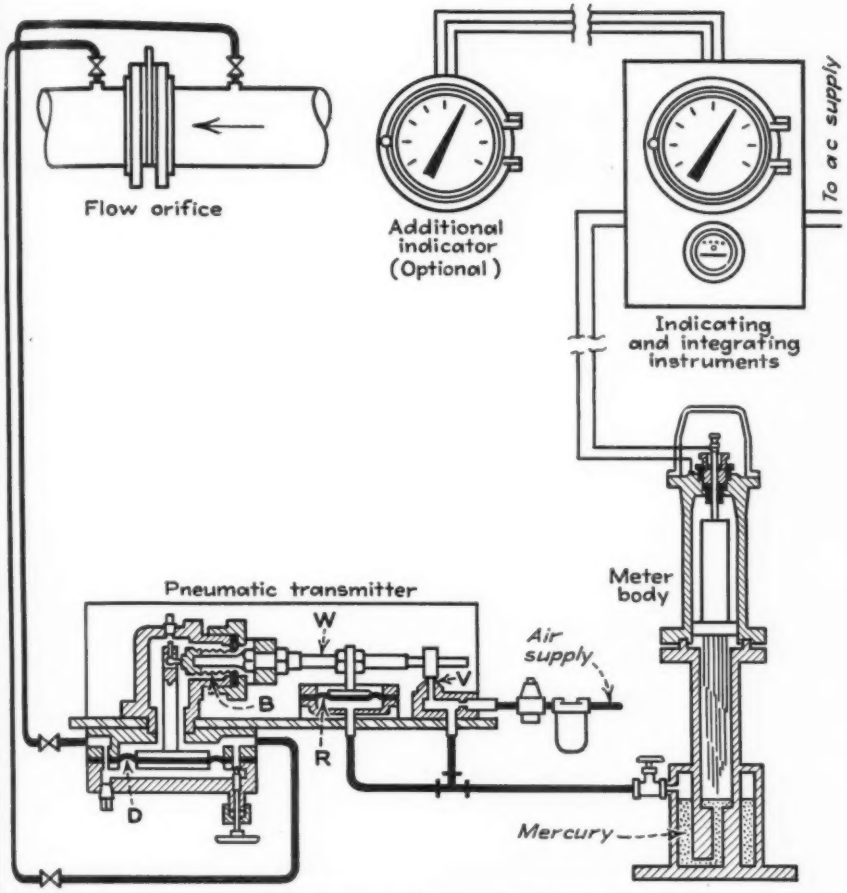


Fig. 3—Combination pneumatic-electric indicating and integrating flowmetering system for measuring rapidly fluctuating flow, overcomes meter sluggishness

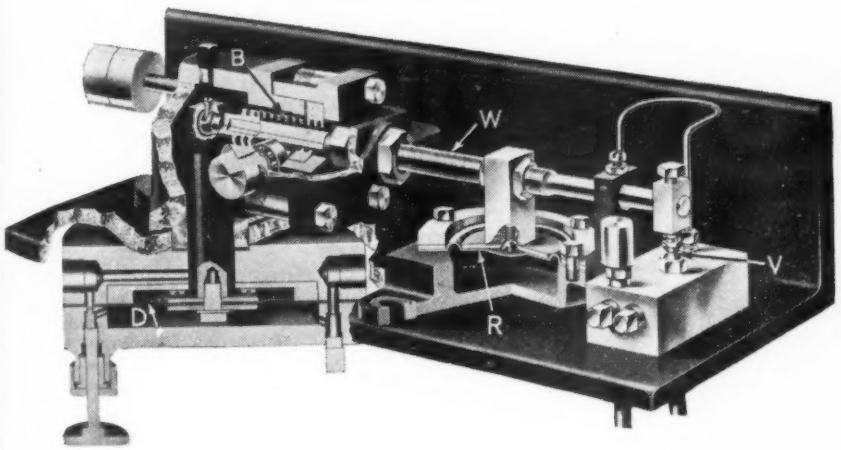


Fig. 4—Pneumatic transmitter that extends the differential pressure range of electrical flowmetering system by establishing air-loading pressures proportional to flow

sented by the average of the square roots of the differentials, and the meter reading would therefore be high.

B. Even if the meter could respond to rapidly fluctuating flows so that a chart would give a true flow record, a chart speed necessary to keep individual fluctuations separated for legibility would be impractical. Customary chart speed of one revolution in 24 hr ordinarily produces only a wide "paintbrush" record of the band of fluctuations (like Fig. 5) with no means of determining duration of each.

C. Practically all automatic mechanical integrators operate on a definite time cycle, the fastest cycle ordinarily being 15 sec. Integration may occur anywhere within the fluctuation band and, therefore, may not represent average flow. Total integration may be in error any amount between maximum and minimum readings of the fluctuation band.

Obviously, there is no satisfactory practical solution to objection 2. However, 1 and 3 may be overcome largely by using a sensitive meter element and a sensitive continuous integrator. Objection 1 would be eliminated in a meter that would respond instantaneously to all changes in flow rate, which is not possible theoretically. Practically, effects of No. 1 may be reduced by proper design to where the error does not exceed permissible limits. Doing so would be useless unless objection 3 were also eliminated by using a continuous integrator sufficiently sensitive to follow the changes in flow rate.

The electric integrator, Fig. 1, operating on a modified watthour principle, has proved able to meet these requirements. In the figure, the ac supply to transformer T provides 40 v for meter operation. Wiring shown in heavy line is the current circuit; that in light line, the potential circuit. The meter body varies current-circuit resistance with changes in flow, so that circuit conductance is directly proportional to flow.

Design of the Integrator

Design of the integrator, developed from the principles of the standard watthour meter, measures conductance of the current circuit to correctly measure flow. Current coil C produces the driving or accelerating force. An electromagnet energized by potential coils P produces the retarding force. This provides a true measure of circuit conductance and the integrator-disc speed is directly proportional to flow.

The indicating, or the recording instruments operate in a similar manner with the pull of potential coil P_1 opposing the pull of current coil C_1. With zero flow through the orifice, no current will flow through coil C_1 and the instrument pointer reads zero. With an increase in current through coil C_1 the pointer moves across the scale to maintain a linear relationship between circuit conductance and pointer position. Coils P_1 and C_1 are wound so that ac voltage changes are compensated, because changes in coil strength are proportional to voltage changes and these coils oppose each other. A metering circuit like Fig. 1 can have only one integrator, but may include from one to three indicators or recorders located at different points.

Acceleration and retardation of the integrator disk, Fig. 1, are practically instantaneous. If the current circuit is opened at maximum current, the disk coasts less than one-half revolution. Acceleration of the disk is equally

(*Continued on page* 146)

Radiant Heating Serves War Plant

Ernest L Blair, industrial engineer, Stone & Webster, describes a new building heated entirely by floor and wall panels. His outline of design and installation methods makes this article unusually valuable to engineers interested in this much discussed heating method

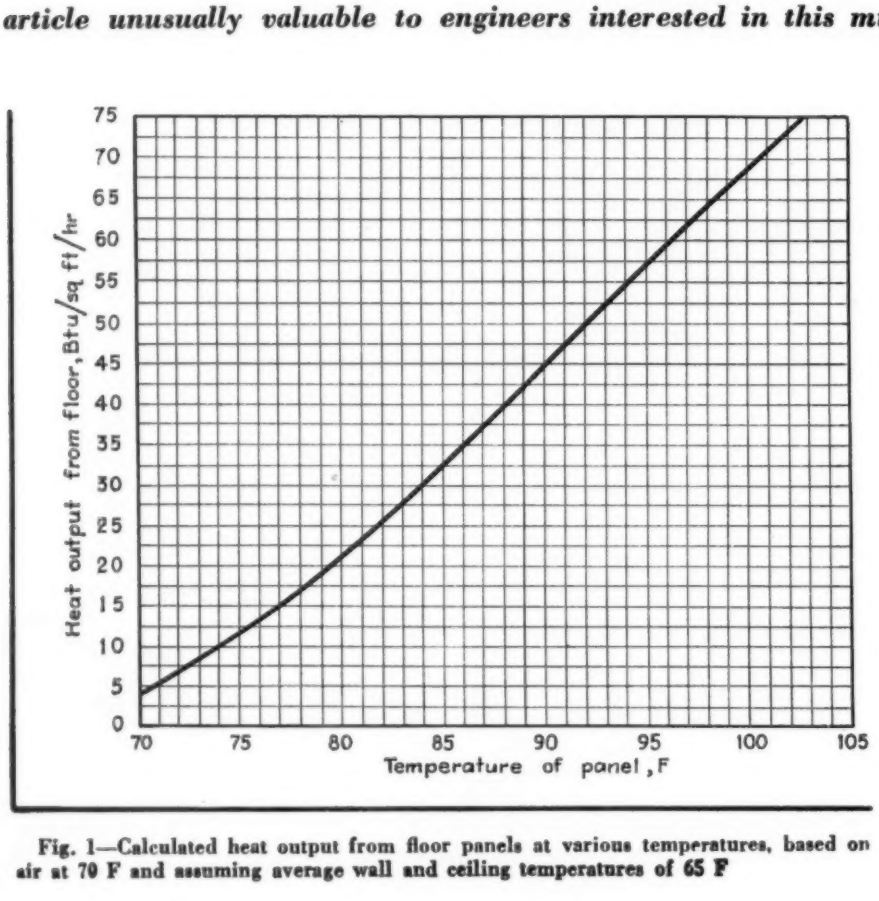
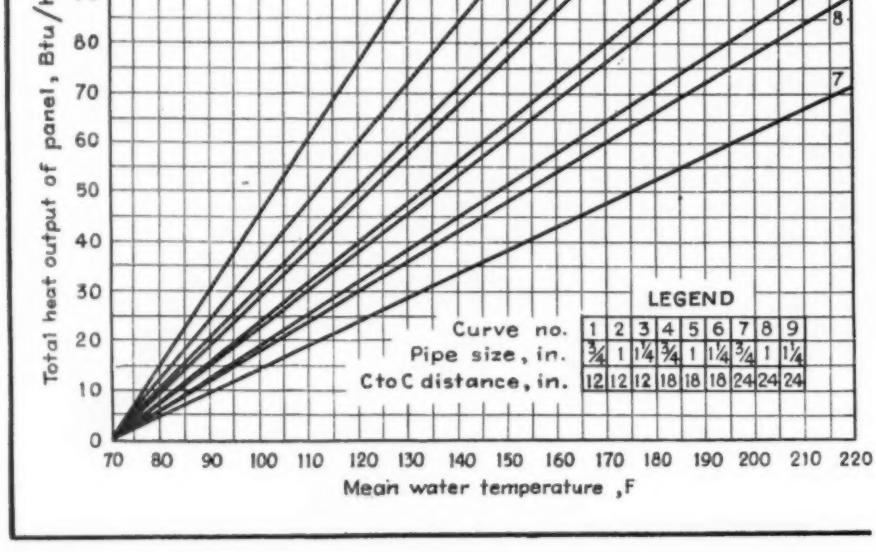


Fig. 1—Calculated heat output from floor panels at various temperatures, based on air at 70 F and assuming average wall and ceiling temperatures of 65 F



► IN RECENT YEARS, the possibilities of radiant heating have intrigued many engineers. Its merits have often been extolled in print, but actual installations are comparatively few and the buildings are in general small, or radiant-heating equipment is supplemental only. The few reports of large jobs have usually given little information about design and installation.

We look with interest, then, at a recently completed one-story building without basement, 80 ft by 280 ft long. One of a group of industrial buildings designed and constructed by Stone & Webster Engineering Corp to provide additional war-production facilities, this building uses a minimum of critical materials and is essentially utilitarian. Walls are brick, sash is wood, columns wood, roof trusses prefabricated plywood, roof insulated plywood and floor concrete.

Selection of radiant heating gives certain practical advantages: 1. Building's entire interior width is available for desk and working space. 2. Eliminating exposed radiation and piping makes interior more attractive. 3. Radiant heating eliminates trenches for return lines, a number of which would have been required at the several exterior doors even if return lines had been exposed on the walls.

Building Arrangement

The personnel department occupies the building's west end, which comprises 6400 sq ft and is divided into reception and waiting rooms, interview, examination and medical-analysis rooms. Remainder of the building, comprising 16,000 sq ft, includes two cafeterias each seating 450 people, and a kitchen centrally located between the cafeterias.

As floors were to be concrete, heating coils were installed in the floor slab. Small areas, which need more

Fig. 2—Relation between heat dissipated per sq ft of panel surface, mean water temperature, and size and spacing of ferrous pipe. Based on 3.5 Btu per hr per sq ft of pipe surface per deg F temperature difference, water to air

heat than the slab could give off, required a few panels in partitions. Hot water was chosen as the heating medium because of the low temperatures possible and the convenience of distribution control with forced circulation. The floor slabs were divided into four sections, comprising the building's four areas. Perimeter of each slab was separated from the building's side walls and from each other by expansion joints, which were inserted around the columns so that the slab in each section was free to move as the concrete temperature changed.

Heat losses from the building, which were calculated in the conventional manner, assuming air temperatures of 70 F for office space and 65 F for cafeteria space, were as follows (Btu per hr):

West-end personnel zone	157,000
Center cafeteria zone	120,000
Kitchen zone	94,000
East-end cafeteria zone	160,000
Total	531,000

Sufficient pipe surface was installed to overcome this total loss of 531,000 Btu, plus an allowance of 149,000 Btu to compensate for heat loss into the ground. Total installation included 15,000 linear ft of pipe, of which 13,500 ft was 1 in. and the balance ¾ in., 1¼ in. and 1½ in. Total calculated heat loss represented 1.85 Btu per hr per cu ft of heated space, which compares with a reported amount of 1.1 Btu per hr per cu ft heated space for buildings in Europe where lower temperatures are maintained and weather conditions are not so severe.

Design was based on a mean water temperature of 105 F at 0 F outside temperature and a temperature drop in the system of 20 F. Maximum temperatures of floor slabs in constantly occupied areas were calculated not to exceed 85 F. Floor temperatures for entrances, toilets, etc, were calculated up to 96 F because length of occupancy is limited and physical discomfort would not result by foot contact with surfaces at this temperature for short periods.

Basis for required temperatures of the floor slabs in the different areas and size and spacing of pipe coils to furnish this were determined from data originally published in an article in September, 1941, *Plumbing and Heating Business:* "A Working Method for Calculating a Floor Type Radiant Heating System." Fig. 1 and 2 are adapted from this article. For the east-end cafeteria, which has an open area of 5,520 sq ft with three wall exposures, calculation was as follows:

Heat output required of the floor panel:

$$\frac{160{,}000 \text{ Btu heat loss}}{5{,}520 \text{ sq ft}} = 29 \text{ Btu/sq ft/hr}$$

Required floor temperature: Fig. 1 calls for a floor temperature of 83 F, which is below the 85 F desirable maximum for this occupancy

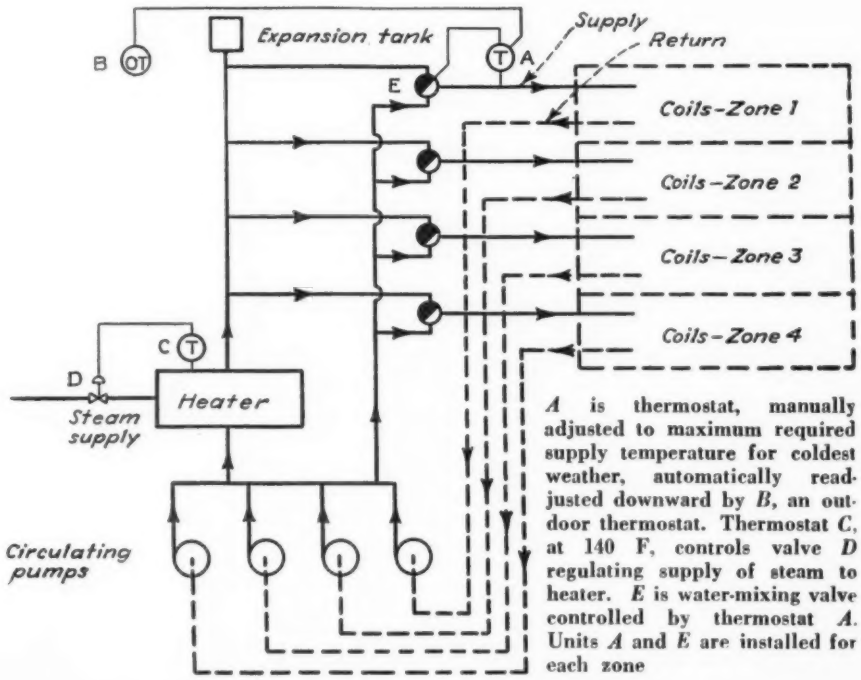
Amount of heat required to offset flow of heat into ground: Allow 30% (floor slab to be installed directly on tamped earth) $29 \times 0.3 = 8.7$ Btu per sq ft per hr

Total input to be supplied to floor:

$$29 + 8.7 = 37.7 \text{ Btu/sq ft/hr}$$

Size and spacing of coils to supply this amount: Assuming 105 F mean

(*Continued on page* 154)



A is thermostat, manually adjusted to maximum required supply temperature for coldest weather, automatically readjusted downward by *B*, an outdoor thermostat. Thermostat *C*, at 140 F, controls valve *D* regulating supply of steam to heater. *E* is water-mixing valve controlled by thermostat *A*. Units *A* and *E* are installed for each zone

Fig. 3—Four-zone radiant-heating hookup with forced circulation of hot water

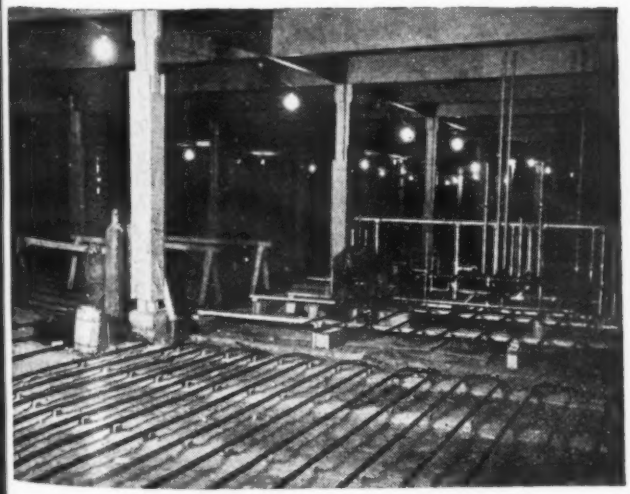


Fig. 4—Pipe coils in place before pouring concrete slab

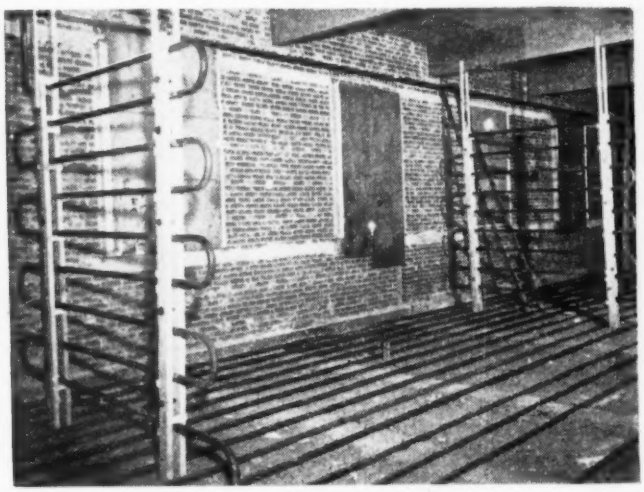


Fig. 5—Typical arrangement of pipe coils for wall panels

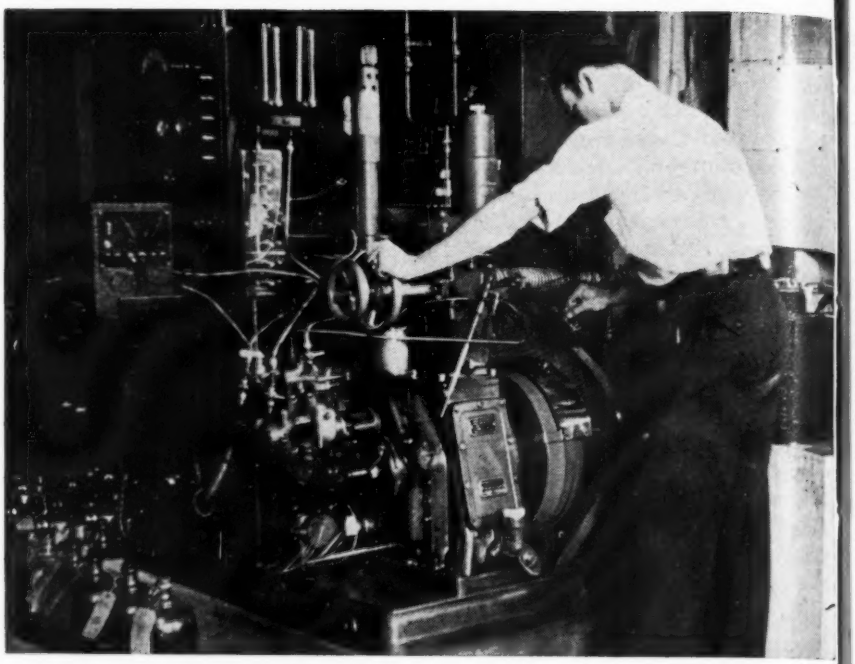


Fig. 1—Testing fuels in a CFR engine with the Penn State ignition-lag indicator

More Hp per Lb of Diesel—2

Scanning the past to estimate the future, Dr P H Schweitzer, Professor of Engrg Research, Pennsylvania State College, shows what has been and can be done to cut weight and boost output. In so doing, he presents an unusually clear picture of the diesel fundamentals every power engineer should know

► Being stymied by excess air, as the preceding article explained, engineers began to think of other means to increase diesel power output. What they were primarily interested in, of course, was the most power in the smallest possible package; weight per hp concerns the diesel designer just as much as the aero-engine designer. Despite the lift submarine use gave to diesel progress during World War I, ten years later engines still weighed about 100 lb per hp. With such a weight the diesel could not hope to find use in tractors, trucks, power boats and locomotives, let alone airplanes.

Engineers searched for new ways to cut engine weight. They had to give up the idea of using fuels of higher Btu. Chemists say no such fuels can be found or synthesized. However, it's not the amount of fuel that limits power, but the amount of oxygen that can be fed into the cylinder every minute. Because air is the only practical source of oxygen, ability to take in air measures a diesel's success; the more air the more power.

A natural answer is to make the cylinders larger, to hold more air. That indeed has been done. Size, however, does not help in reducing weight per hp. Three other ways are left to increase air-taking capacity: (1) Fill cylinders more often by increasing rotative speed. (2) Fill cylinders more often by cutting out idle strokes and filling every stroke, or even twice a stroke. (3) Squeeze more air in the same space by putting it under pressure. Diesel engineers have explored all these paths. Let's see what resulted:

Early Diesels Low Speed

Early diesels, slow-speed machines, ran like steam engines at 100–200 rpm. The submarine gave the first incentive to step up speed. Double speed and you double power. Rotative speed gradually increased to 400, 600 and 800 rpm. This was made possible by better lubrication, lighter reciprocating parts and, mainly, by changing to solid injection. But this was still not enough to put diesels into automotive vehicles. The gasoline engine runs at 3000–4000 rpm. Engineers asked, "Why can't we run diesels that fast?"

Between 1930 and 1940 and almost simultaneously in Germany, England and the United States, the automotive diesel was developed. Now tractors, large trucks and buses are equipped almost exclusively with diesel engines and these small high-speed units are so much like the gasoline engines they have replaced that a layman cannot tell them apart. There is, however, a significant difference: They give almost twice as many miles per gallon as the carburetor engine they replace, and do it on cheaper, safer fuel.

The most important single contribution to the success of the automotive diesel is the compact high-precision fuel-injection pump. These mechanical marvels meter fuel quantities no bigger than the head of a match under enormous pressure and with an astounding uniformity.

Maximum rotative speed of present-day automotive diesels stands at a little over 2000 rpm. This still falls well short of gasoline-engine speeds. Are we at the end of our rope? Pretty nearly.

Two obstacles stand in the way of further speed boosts. One has already been discussed as responsible for excess air—the mixing process. To insure clean combustion, fuel and air must mix in the early part of the piston's power stroke. At 600 rpm, 30 deg crank angle corresponds to 1/120 seconds and that is short enough. But at 2400 rpm the same crank angle corresponds to only 1/480 seconds, and to mix air and fuel intimately in that time is a real problem. The carburetor engine faces no such problem because fuel and air mix in the carburetor and a uniform mixture enters the cylinder.

The other factor, not suspected until about 15 years ago, proved the most obstinate drag on speeding up the diesel. It is *ignition lag.*

Diesel Ignition Lag

In a diesel, we think of fuel igniting the instant it hits the highly heated air. It was assumed that it *must* if air temperature exceeds fuel self-ignition temperature. But it does not. There is a delay. How much? About 0.002 seconds. One may think that a delay of that magnitude cannot be serious, but it is. At 2400 rpm, 0.002 seconds cor-

responds to 28.8 deg of crank rotation. That is so long that it is liable to prevent ignition altogether and to cause *missing*. Even before that happens we face combustion knock, which may pass the nuisance stage and become intolerable.

The longer fuel hesitates to ignite the faster and more violently it burns when it lets go. That becomes clear when we stop to think that fuel accumulates in the cylinder during the ignition-delay period. The injection period lasts 15 to 30 deg. depending on the engine. If all the fuel charge or a great part of it is already in the cylinder when ignition occurs, all that fuel will ignite practically instantaneously and explode with a violence as if thousands of spark plugs had set it off at once.

Diesel Combustion Knock

Diesel combustion knock is similar to detonation in gasoline engines and is just as destructive if not checked at an early stage. Yet significant differences exist.

Almost every factor that causes a gasoline engine to knock is likely to make a diesel run smoother, and what is *anti*-knock in a gasoline engine is *pro*-knock in a diesel. High compression ratio is considered a primary cause of gasoline-engine knock, while a rough-running diesel can be made smooth simply by raising its compression ratio. High intake-air or cylinder temperatures make a gasoline engine knock, but have the opposite effect in a diesel. Anti-knock dopes for gasoline like tetraethyl lead are pro-knock in the diesel while ethylnitrate is the reverse. Paraffin-base fuels from Eastern crudes, consisting mostly of saturated straight-chain hydrocarbons are the worst knock offenders in gasoline engines and the smoothest, most desirable fuels for diesels. West Coast aromatics and cracked fuels burn roughly in diesels, but command a premium for carburetor engines. High altitudes or low-intake-air density make a diesel knock; supercharging suppresses the knock. With carburetor engines the reverse is true.

Behavior of compression-ignition and spark-ignition engines with regard to knocking runs so completely opposite that doubt has been raised about the identity of the two actions. Nevertheless, in essence the knocking process is always the same. In both cases it is accompanied by very fast burning and an excessive rate of pressure rise. While critical rate varies somewhat with cylinder size and other factors, ordinarily both gasoline and diesel engines run smoothly if maximum pressure-rise rate is less than 30 psi per deg crank rotation. Both are likely to knock if pressure rise exceeds 50 psi per deg, and almost certain to knock if it goes to 100. It has also been established that in both engines knock is preceded by spontaneous ignition of a portion of the combustible charge in the cylinder. But here all similarity ends.

In a spark-ignition engine, rapid pressure rise takes place and knock occurs at the last stage of combustion. It is the *last gas* to burn that knocks. The first gas ignited by an electric spark certainly could not knock because only the gas adjacent to the spark ignites, a minute quantity. Propagation of combustion is a gradual process for a while. The flame front expands and in so doing compresses the unburned part of the mixture. Finally, a point may be reached when the unburned mixture is compressed to its self-ignition temperature. Then this charge ignites in its entire mass, causing an extremely rapid pressure rise and a sharp knock, or detonation.

In a diesel, on the contrary, combustion *begins* with spontaneous ignition. This is the "legal" method of ignition. But self-ignition need not cause detonation, as thousands of smooth-running diesels testify. The determining factor is *how much* fuel ignites simultaneously. The more fuel that ignites at once, the steeper the pressure rise and the more severe the knock.

It is at this point that ignition lag enters the picture. The fuel injected does not ignite instantaneously. It takes one to four milliseconds to ignite the fuel charge already in the cylinder. Length of ignition lag depends on fuel quality and cylinder pressure and temperature. The longer the lag the more fuel accumulates in the cylinder before ignition. When ignition does occur, nearly all this accumulated fuel ignites simultaneously. Therefore, the longer the ignition lag the more severe the knock.

Ignition Differences

This difference in ignition characteristics explains the divergent behavior of diesel and gasoline engines. All factors which reduce ignition lag have, therefore, anti-knock effect in a diesel engine. High compression ratio, high intake-air temperature and pressure—all accelerate ignition and thus shorten ignition lag and suppress knock. By the same token these very factors speed up combustion in the gasoline engine, produce spontaneous ignition in the last portion of the charge and cause detonation. High-octane fuels burn slower and thereby prevent detonation. High-octane fuels would do very poorly in a diesel, where high *cetane* fuels are desired. Any fuel that has a high

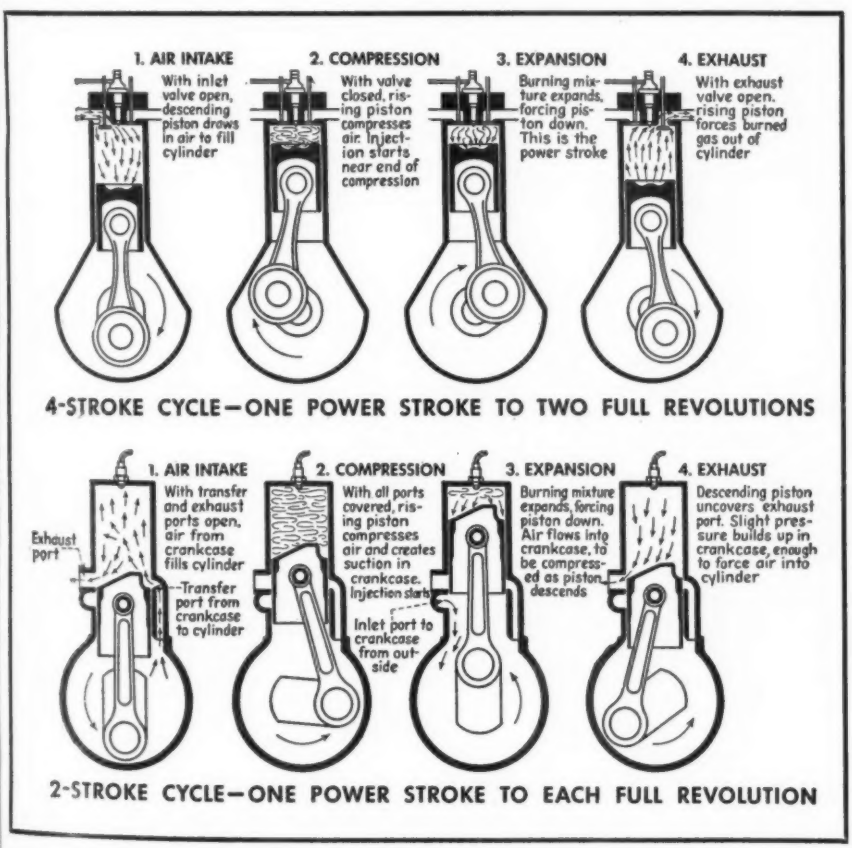

1. AIR INTAKE
With inlet valve open, descending piston draws in air to fill cylinder
2. COMPRESSION
With valve closed, rising piston compresses air. Injection starts near end of compression
3. EXPANSION
Burning mixture expands, forcing piston down. This is the power stroke
4. EXHAUST
With exhaust valve open, rising piston forces burned gas out of cylinder
4-STROKE CYCLE—ONE POWER STROKE TO TWO FULL REVOLUTIONS
1. AIR INTAKE
With transfer and exhaust ports open, air from crankcase fills cylinder
Exhaust port
Transfer port from crankcase to cylinder
2. COMPRESSION
With all ports covered, rising piston compresses air and creates suction in crankcase. Injection starts
Inlet port to crankcase from outside
3. EXPANSION
Burning mixture expands, forcing piston down. Air flows into crankcase, to be compressed as piston descends
4. EXHAUST
Descending piston uncovers exhaust port. Slight pressure builds up in crankcase, enough to force air into cylinder
2-STROKE CYCLE—ONE POWER STROKE TO EACH FULL REVOLUTION

Fig. 2—Diagrams above show how the 2-stroke cycle compares with the 4-stroke

octane number has a low cetane number, and vice versa.

The highest quality diesel fuels, running close to 100 cetane number, have, under favorable conditions, ignition lag of approximately 1/1000 seconds. That is about the minimum. Here we face a serious limitation to increasing speed and power of diesel engines. Prospects that the diesel will attain top speed of the gasoline engine are slim indeed.

If one comes to a dead end on one road, it is only natural to try another. Reducing diesel weight is the same problem to the engineer as increasing its power. After all, it's lb per hp that counts, and the more hp we get out of a certain amount of metal the better off we are.

Earlier we saw that the factors that control power output of an engine are thermal efficiency, excess air, rotative speed, and the amount of air charged to the cylinder per revolution. It is on this last point, that diesel engineers lately have found much encouragement.

Carburetor engines operate almost exclusively on the 4-stroke cycle. One stroke fills the cylinder with fresh charge, the next compresses that charge, see diagram on page 89. Next comes the power stroke, succeeding ignition at the end of the compression stroke. Fourth stroke pushes burned gas out of the cylinder. Since two strokes mean one engine revolution, the cylinder fills only at every other revolution. From the standpoint of feeding air to the engine, every other revolution is wasted.

As early as 1878, it occurred to the British engineer, Dugald Clerk, to build an engine that would utilize every engine revolution to fill the cylinder. He thereby invented the 2-stroke-cycle engine. Clerk's engine was a gas engine operating on the Otto cycle like a gasoline engine. A mixing valve, corresponding to a carburetor, mixed gas fuel with air. This mixture was forced through slots into the cylinder at the early part of the compression stroke. The mixture was then compressed and ignited at the end of the compression stroke. The power stroke followed and before the piston quite reached the end of the power stroke other slots opened in the cylinder wall, permitting the burned gas to escape to the exhaust.

In a 4-stroke-cycle engine the piston sucks the charge into the cylinder. In the 2-stroke cycle there is no suction stroke; the charge has to be pressed into the cylinder by a pump or blower. Addition of a low-pressure air compressor or blower is a matter of small consequence compared to the doubling of the number of power strokes, yet the 2-stroke-cycle design made little headway before the advent of the diesel. The reason is simple.

In a 2-stroke-cycle engine both exhaust and intake occur in a short time while the piston is at or near bottom center. The two processes overlap; in fact, the fresh charge scavenges the cylinder of the burned gas. Scavenging with a mixture of fuel and air wastes fuel. If fuel and air mix outside the engine, in a carburetor, this can hardly be avoided. In consequence, 2-stroke-cycle gasoline engines have been used only in small sizes, like outboard engines for small motorboats, etc., where fuel economy is secondary.

In a diesel where pure air is charged to the cylinder, scavenging can be done with air without wasting fuel. This makes the 2-stroke cycle for the diesel practicable. Indeed, the most significant recent advances in diesel engineering pertain to the 2-stroke-cycle engine.

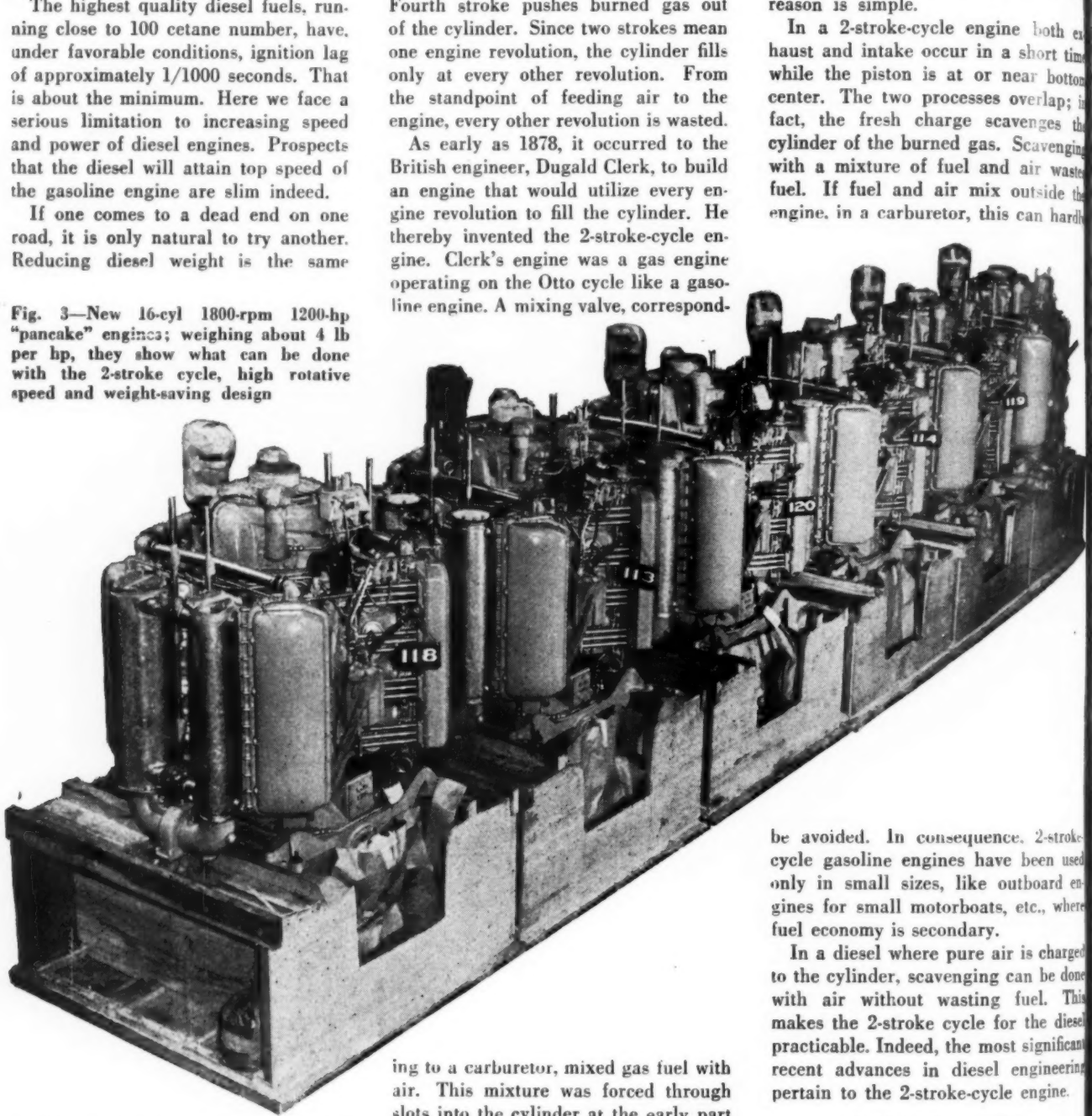


Fig. 3—New 16-cyl 1800-rpm 1200-hp "pancake" engines; weighing about 4 lb per hp, they show what can be done with the 2-stroke cycle, high rotative speed and weight-saving design

Uniflow Scavenging

A recent 2-stroke-cycle design uses *uniflow* scavenging. Air enters through ports in the cylinder wall near the bottom of the stroke and exhaust escapes through poppet valves in the cylinder head. Uniflow or straight through scavenging is more efficient than cross scavenging or loop scavenging, where air has to make several turns in going through the cylinder. Air is supplied by a rotary blower at a pressure of 0.5 psi and the blower is of such capacity that it furnishes about 40% more air than is necessary to fill the cylinders to atmospheric pressure. Most of the extra air is used for scaveng

ng and some of it for supercharging. These 8¾x10½-in. engines develop, at their normal speed of 750 rpm, 108 hp per cylinder. They are usually built in V's of 6, 8, 12 or 16 cylinders. Engine weight runs about 18 lb per hp.

A few years later the same engine type was developed for automotive application. It has 4¼-in. bore, 5-in. stroke, and develops 20.5 hp at 2000 rpm. The weight of a 6-cylinder engine is only 10 lb per bhp.

Latest child of this engine family is the so-called "pancake," a radial engine with four horizontal banks stacked on top of each other. While the principle of this 2-stroke-cycle engine is the same, weight has been reduced to the incredibly low figure of about 4 lb per hp. This has been accomplished by aircraft cylinder construction and superior design and workmanship throughout. Water jackets are corrugated sheet metal and are welded on the cylinder, thereby eliminating heavy framework. High-speed centrifugal blowers are used for scavenging with ports for intake, and poppet valves in the integral heads for exhaust. The engine has 6-in. bore and 6½-in. stroke and develops 1200 hp at 1800 rpm. It is no doubt the most advanced marine diesel in regular production.

The other significant 2-stroke-cycle development is the opposed-piston engine. Originally invented by the German professor, Junkers, small-bore engines of this type weighing as little as 3 lb per hp have been used successfully in airplanes abroad.

The superiority of the opposed-piston engine derives from the fact that it has no cylinder head. Two pistons move in the same cylinder, opposite to each other, and combustion takes place in between. Consequently, heat loss through the cylinder head is eliminated. The opposed-piston arrangement permits uniflow scavenging by admitting fresh air through a row of ports at one end of the cylinder, and exhausting it through another row of ports at the other end. One piston controls the inlet and the other piston controls the exhaust. As a result, the long cylinder is effectively scavenged.

Opposed-Piston Engines

Suitability of these engines for submarine service was recognized, and one American company began building them in 1932. These units have 8-in. bore, 10-in. stroke by each piston, and run at 720 rpm, normally. They have two crankshafts, one on the bottom and one on top, geared together in such a manner that the exhaust piston has a 12-deg advance over the intake piston. This lead to the exhaust permits the cylinder pressure to drop before the inlet ports open and effects some supercharging. The fuel economy of these engines is excellent.

One way of doubling the number of power strokes without increasing the engine speed is to go to 2-cycle. Another way is to make the engine double-acting. One American builder does both; besides using the 2-stroke cycle they make the engine double acting. The piston has two crowns, one on top and one on the bottom. Air is admitted alternately to both sides of the cylinder and fuel is admitted to two sets of injection nozzles. One injection nozzle is always located on top in the center of the cylinder head and two on the bottom on the side of the piston rod. The piston rod, extending through a stuffing box, connects to a crosshead which drives connecting rod and crank. In this way every piston stroke is a power stroke and in spite of the rather low rating their 9-cyl 9.0625x13.3750-in. 700-rpm engine develops 1535 rated bhp, which brings specific engine weight down to 18 lb per bhp.

The most efficient type of scavenging for 2-stroke-cycle engines is the uniflow or straight-through scavenging. One can trap roughly 20% more air in that manner than by cross or loop scavenging. There are just three ways known to produce uniflow scavenging in a cylinder

(*Continued on page* 160)

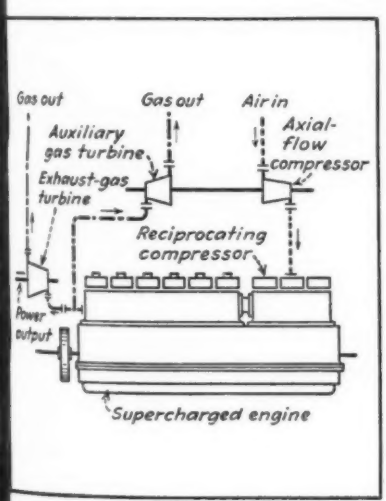
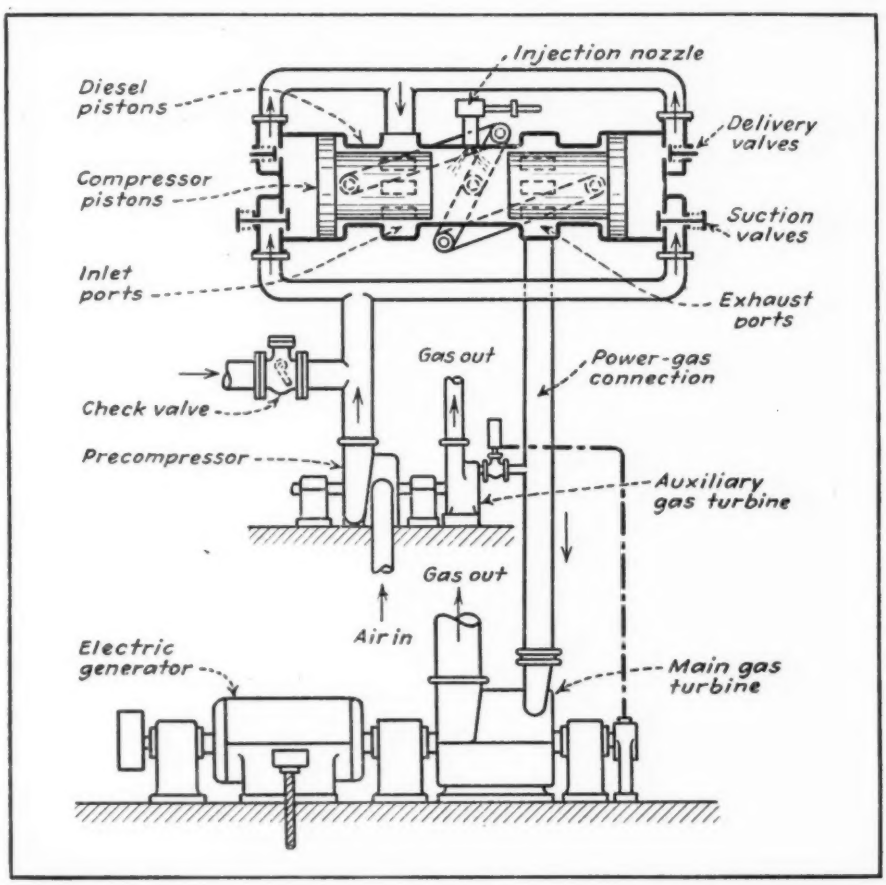


Fig. 4—Power-gas process with precompression for charging pressures above 75 psi gage where compressor power absorbs all power developed by engine

Fig. 5—If supercharging with an exhaust-gas turbine is carried beyond a certain point, the diesel ceases to produce power and becomes merely a compressor for the gas turbine, which generates all the power. Diagram, right, shows a unit designed on this basis, using a free-piston diesel compressor, which supplies exhaust gas to drive an auxiliary precompressor and main gas-turbine-generator



BYPASS Protects Hig

High-head pumps have to dissipate large amounts of heat at flows and thus require recirculation bypass for safe opera

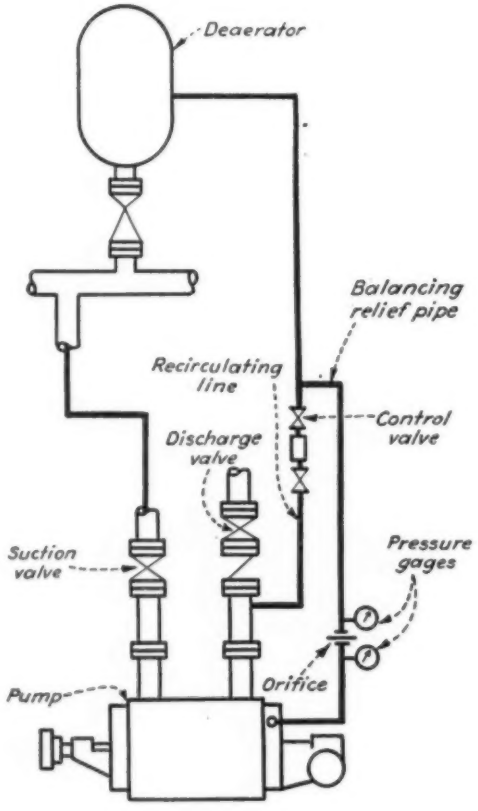


Fig. 1—Recirculating line and balancing device leakoff arrangement for single feed pump taking from single heater

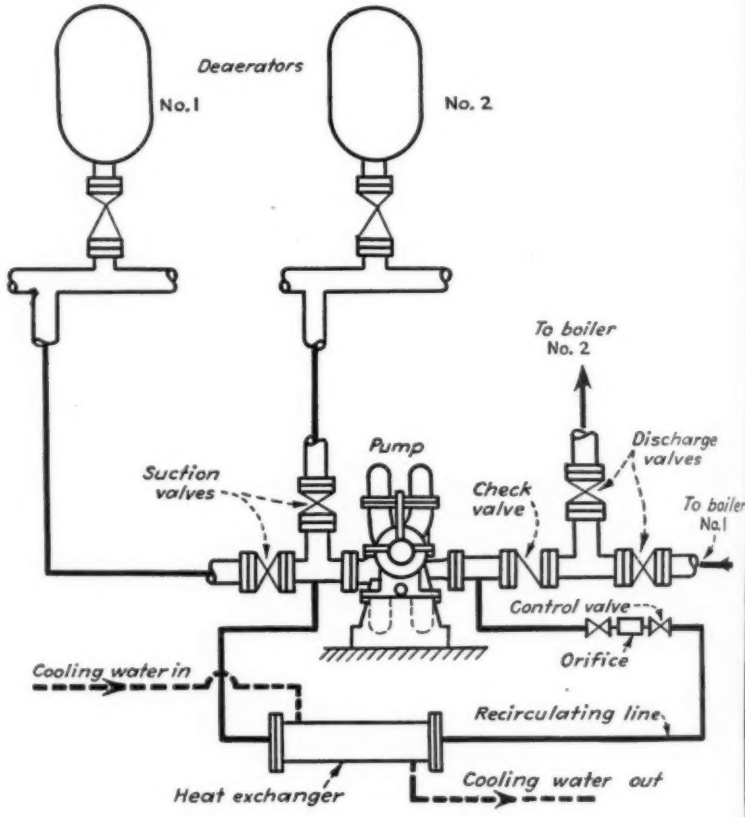


Fig. 2—Separate heat exchanger with its own cooling water supply may be best solution where bypass must return to pump suction because it is impracticable to return water to heater or because two heaters may be operating at different pressures

► To avoid excessive temperature rise of feedwater within a high-pressure centrifugal boiler-feed pump, it has become accepted practice to set a minimum permissible flow by providing a bypass from the pump side of the discharge check valve back to a direct-contact heater or some other convenient point. Temperature rise greater than 15-20 F can lead to complete interruption of pumping action and also to early failure of pump parts.

The recirculation bypass normally includes either manual or automatic shutoff when flow through the pump exceeds the set minimum. Under usual operating conditions, when all running boiler-feed pumps handle a flow well above the danger point, bypasses remain closed. Whenever there is a possibility of operating at light flow, or against a closed check valve, the operator must have assurance that the bypass will be open and remain so until normal flow is again established.

Manually Operated Bypass

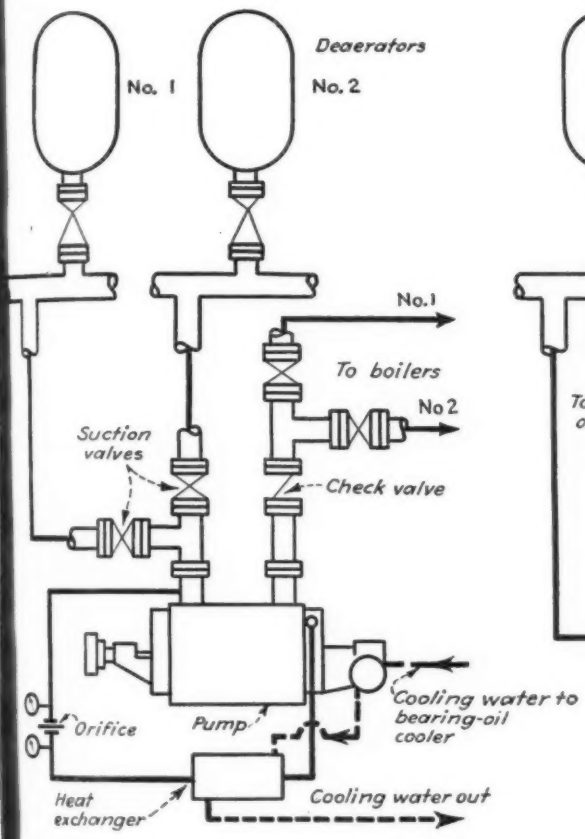
Where bypass valves are manually operated, standard procedure for changing from main to standby pump and back should include opening these valves on all pumps before the switch is made. Only after normal conditions have been reestablished should the bypass valves be again closed. If the standby pump is operated automatically, either its bypass valve must remain open continuously or automatic provision made for opening it at the proper time.

Bypass valves can be left open on all idle pumps without loss of heat or pumping head if the recirculating line leads back to the direct-contact heater. If the bypass leads to some point of lower pressure, only a slight flow will exist in comparison to that produced by the full pump head. A throttling orifice is always incorporated in a recirculating bypass, and a typical high-pressure pump that normally recirculates 90 gpm has only something like 20 gpm flow to the condenser when the pump is idle. This flow also serves to keep the pump warm as generally recommended for standby units.

If the recirculation bypass is auto-

essure Boiler-Feed Pump

*Karassik, Worthington pump expert, details arrangement of g for recirculation, balancing device and vent lines **



ig. 3—Balancing device leakoff can be returned to pump suction through small cooler in series with bearing-oil heat exchanger to use same cooling-water supply

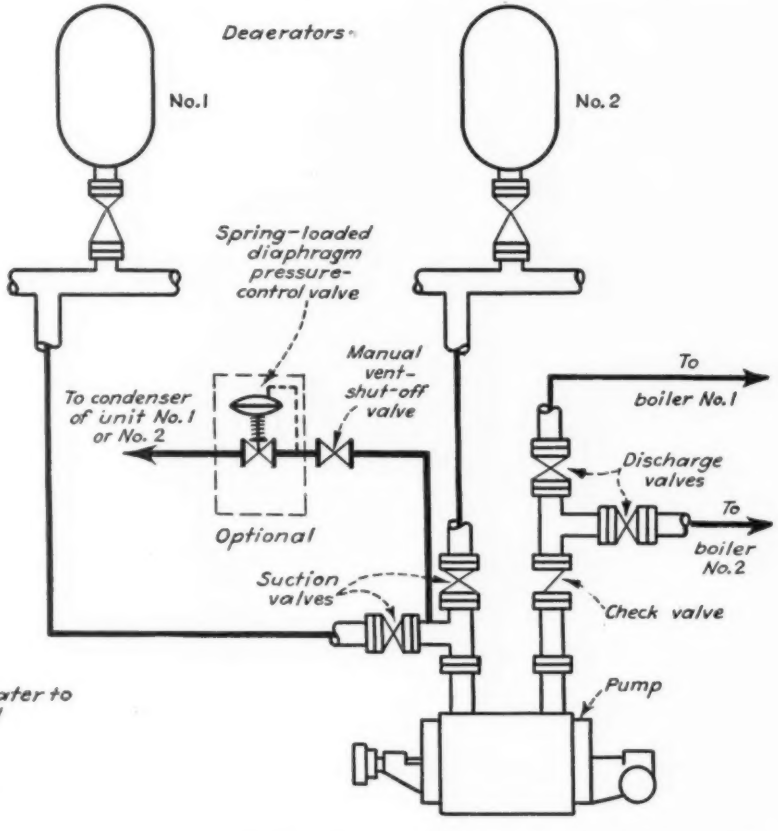


Fig. 4—If spare pump serves two systems with different deaerator pressures, vent line to condenser avoids flashing in pump suction line on starting

atically operated, the control problem isappears altogether. The bypass remains open as long as the pump is idle nd until the flow through the pump eaches the predetermined desirable inimum.

The usual piping arrangement is diagrammed in Fig. 1. A recirculating ne connects to the pump discharge ead of the check valve and can be ut off by manual or automatic valves. n orifice is sized for the set minimum ow. Leakoff from the balancing device, if one is employed, joins the bypass line after the shut-off valves so at all water returns to the direct-contact heater.

The balancing leakoff cannot be closed by valves as it is intended to operate at all times the pump is in service. An orifice and two pressure gages indicate the amount of leakoff actually flowing.

Two or More Turbines

Where two or more main turbines are involved, having two or more direct-contact heaters that may operate at different pressures, the recirculating bypass cannot be returned to one of the heaters in such a simple manner. If the several units operate independently, bypass of water to a heater other than the one from which an individual pump takes off may upset the distribution of feedwater between the two systems. In the extreme case, one system constantly disgorges excess water through the heater overflows while the other constantly calls for additional makeup.

Since it would be impracticable to switch the point of bypass return with every change of main pump connections, recirculated water should return to the individual pump suction at some point on the pump side of the suction valves. This arrangement obviously requires the use of a heat exchanger, Fig. 2, in the recirculating line to take away the heat that is absorbed in the pump.

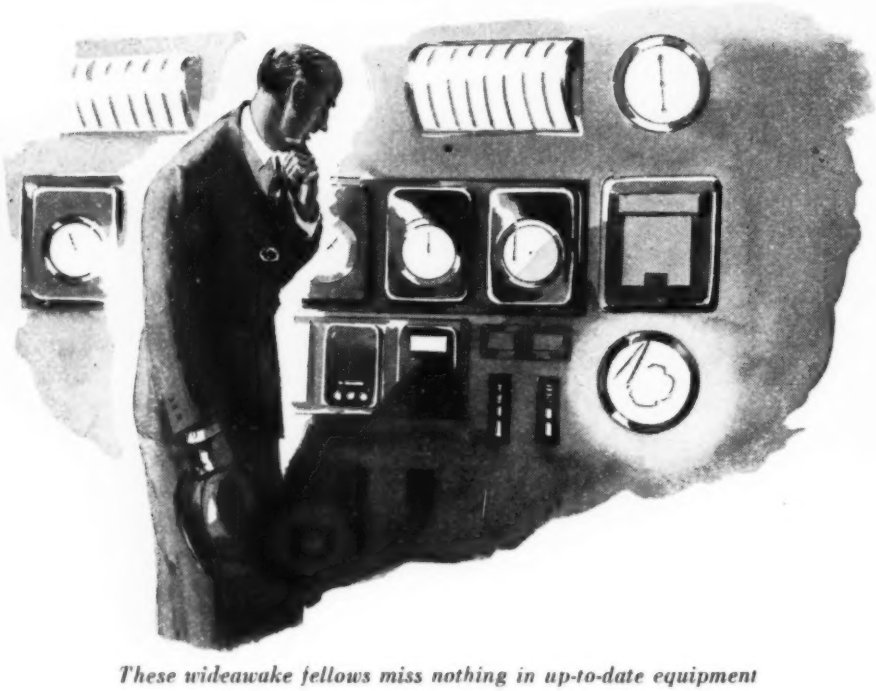
Calculations to determine size of heat exchanger are simple. With pump operating at shutoff, the temperature

(*Continued on page* 168)

* From a paper that won first prize in the "practical" ...s of the Hydraulic Institute contest. Republication ...ts reserved.

THE OLD CHIEF

BORN COPY CATS



These wideawake fellows miss nothing in up-to-date equipment

What if you aren't a graduate engineer? No need to hang back. The Chief remarks on the knack small-plant engineers have for copying the larger fellow. Another in the series by William Doran, chief engineer, Essex County Sanatorium

It has often been said, in respect to an engineer charged with the operation of a large or medium-sized plant, that his success or failure depends to a large extent upon his ability to build up a loyal and capable staff around him. The nice way to do this is to reach out into an overstocked labor market, offer top wages and hire only mature, experienced men whose reliability and acumen are without question. Unfortunately, the opportunity to do this does not present itself in real life, with the result that most chief engineers are forced to hew their finished product from raw material in order to build up their personnel.

Our friend, the Old Chief, is a man born to be the counselor, guide and teacher of all the young men who come in contact with him. Without any trace of paternalism he can start a young man off on a course of study. Later on, by casually asking him to look up this or that authority on some subject, the Old Chief induces him to build up a good reference library for himself.

Then, by asking his opinion regarding the new developments and trends discussed in the current issue of the best of all technical magazines, he induces the youngster to be a regular subscriber. That briefly is the Old Chief's threefold way: an organized study course, a good reference library, and a careful and prayerful reading of POWER every month.

One day while I was still a fledgling, the Old Chief asked me what I thought of a special article that had interested him very much. I confessed that I had skipped it as being too deep for me, thinking in my ignorance that I would get very little out of it. The Old Chief thought that I should have read it. He contended that at least I would have become acquainted with the phraseology of the subject and that with the aid of my reference book I could have understood the writer's arguments.

"Then," he added, "the next time you came across an article on that subject, it would no longer be Greek to you."

Continuing, the Old Chief pointed out that our calling is essentially a technical one, that it is important that we youngsters learn to express ourselves in technical language, and that he knew no better way of increasing our technical vocabulary than by reading and understanding the best modern writers on subjects allied to stationary and marine engineering.

Hot Air

On another occasion, I questioned the practical wisdom of an article on the value of air preheating. I claimed that the writer had started off from the limit of my knowledge of the subject and wafted himself off into the realms of very thin preheated air. I claimed that it was written by a graduate engineer for graduate engineers and was of no practical use to the man in a small plant who might be interested in the subject.

"On the contrary," replied the Old Chief, "I know of three small plants around here where, as a direct result of that article, the engineers have run twelve-inch stovepipe from the hottest point above their boilers to their forced-draft fans, thus increasing the temperature of their air intake from 65 to 75 F. "And before I forget it," he added, "I would like you to take a pencil and notebook and go down to Herb Jones' plant, and work out for me the actual cash savings that he will effect by the use of a couple of dollars worth of stovepipe."

On other occasions I have heard the Old Chief remark on the way the little plants copy the larger fellows. A few years ago, if you visited a small plant you twisted your head twelve different ways to see twelve different gages. Now, you find a well-lighted instrument panel of homemade construction. They build themselves ash elevators, they have damper controls operated by city water, which also operate butterfly valves on the air ducts. They have peak-load alarms on their power meters, they have builtup manifolds that throw their exhaust steam and high-pressure returns into hot-water heating tanks or feedwater heaters, as load requires.

The Old Chief contended that the wideawake engineer in a small plant is a born copy cat. "These fellows miss nothing. If one of them spotted a new handle design on his grandmother's coffin, he would duplicate it somewhere in his plant the next day."

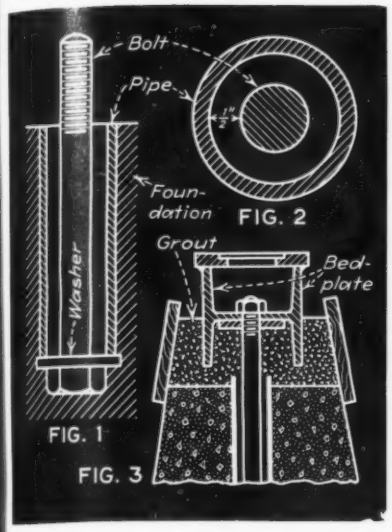


Fig. 1—Method of anchoring foundation bolts. Fig. 2—Section showing clearance between bolt and pipe in foundation. Fig. 3—Correct grouting of structural steel bedplate to its foundation.

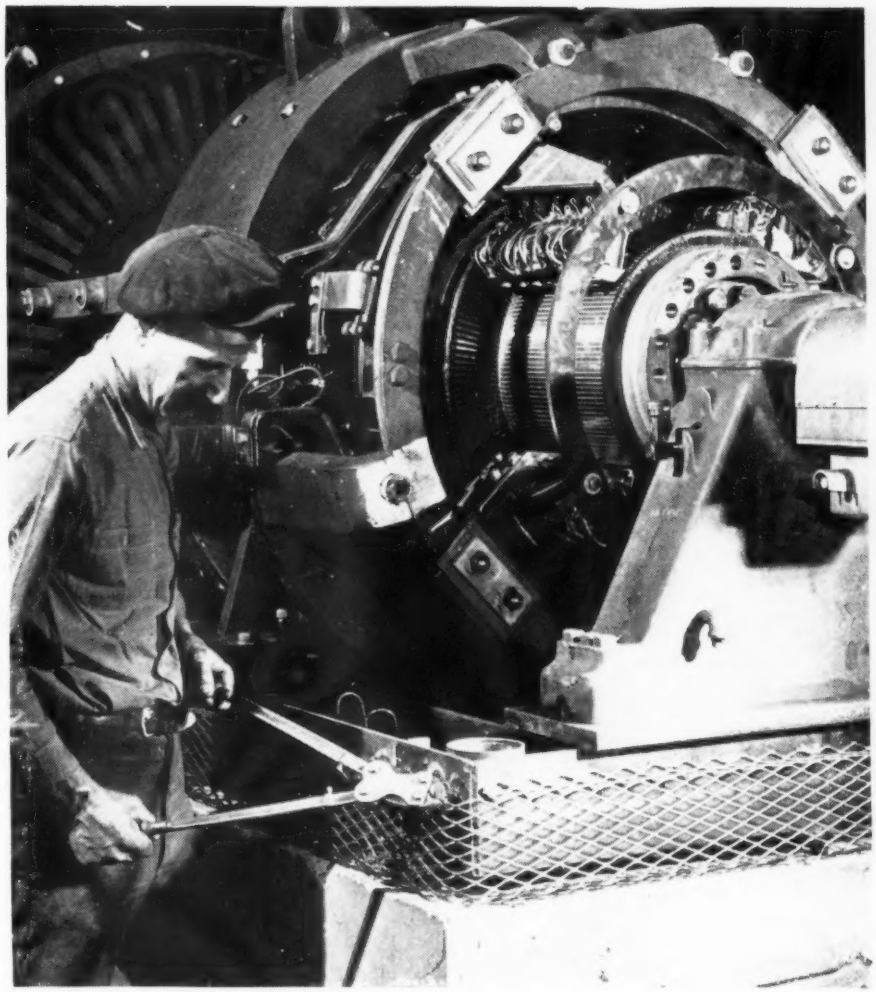


Fig. 4—Main foundation with machine in place. Workman is trimming corners off reinforcing mesh which has been welded to machine bedplate preparatory to pouring the grout.

100 Rules —for Installing Large Motors That Spell Reliable Operation

Proper installation of large motors begins the instant they arrive on the job. Here is the correct program to follow to avoid trouble when putting the machines in service and to insure reliable operation afterward, as outlined by H E Keneipp, Westinghouse service engineer

WHEN speed is a primary factor, rushing the installation of large rotating machinery may bring more or less disastrous results. For proper operation and minimum maintenance, then, give careful consideration to location and installation of large motors particularly when materials and personnel are at a premium.

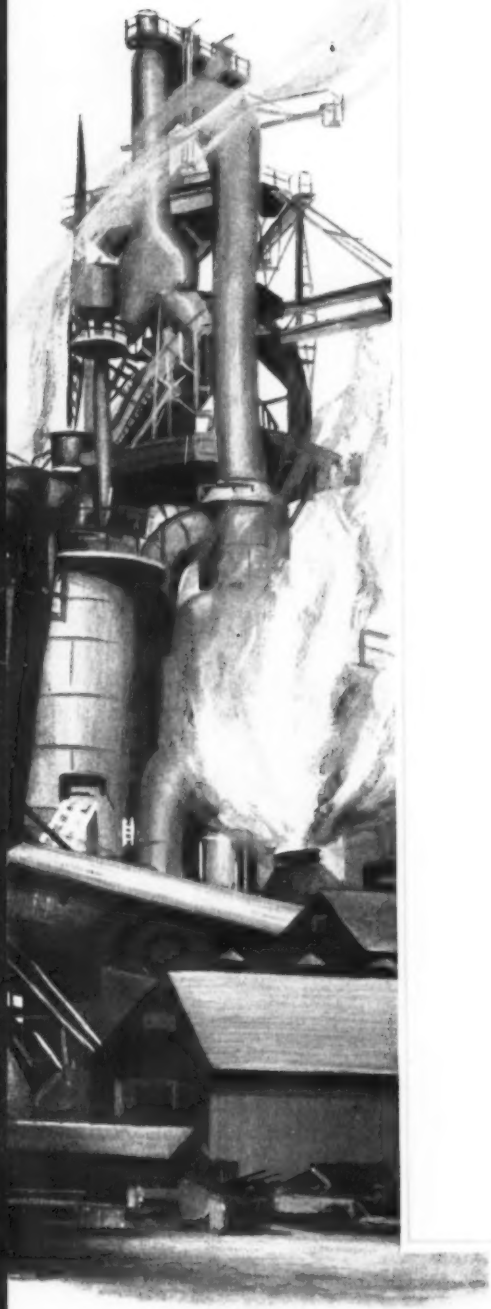
Shipment and handling. Unpack the motor just as soon as it is received, in the presence of a claim adjuster, and report any apparent injuries and breakage to the transportation company and to the supplier. To save time give the motor serial number in all correspondence.

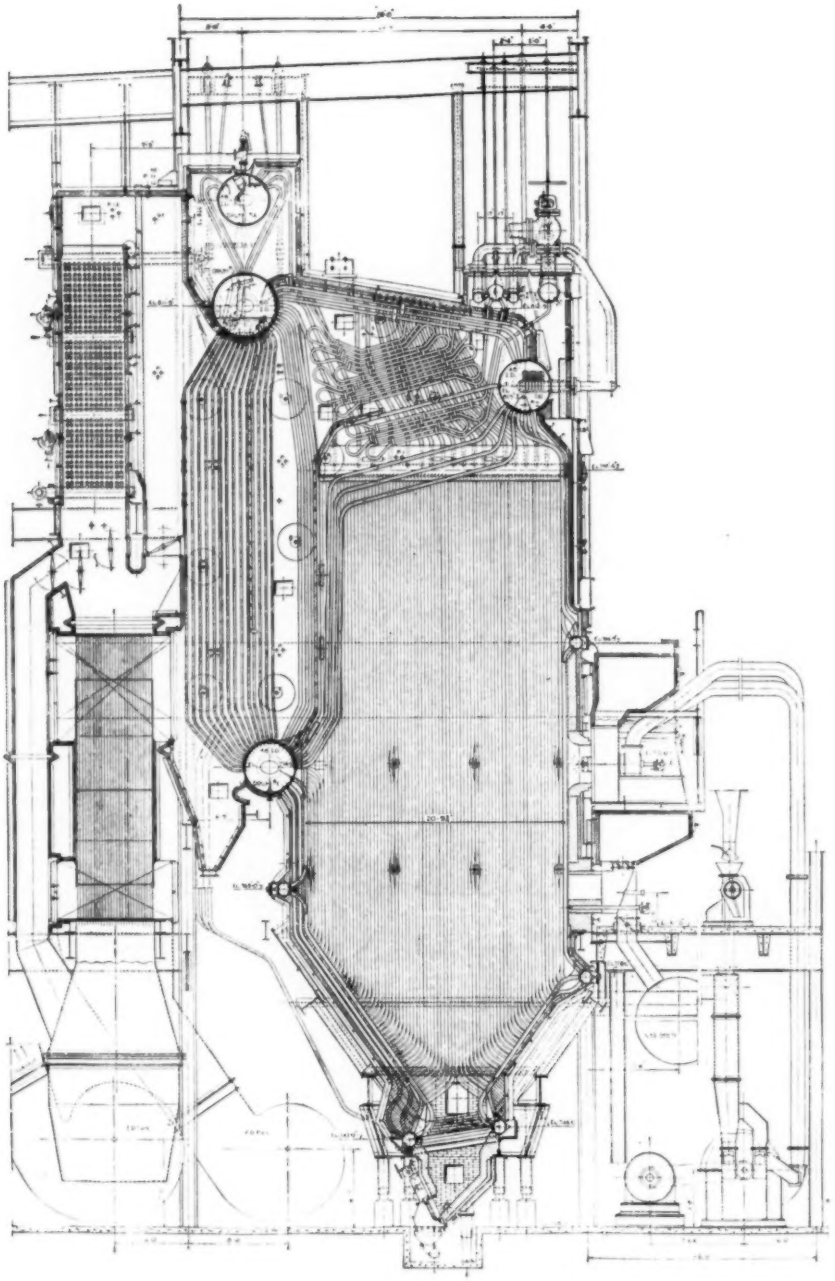
Handling the motor. If eyebolts or lifting bars are provided do all lifting by them. Never lift or support the stator by the core, punching or coils. When lifting a completely assembled machine mounted on a bedplate, attach slings in the openings provided. To avoid bedplate distortion, arrange slings so that the weight distributes uniformly between them. Let the motor's frame feet support it when not being lifted.

Do not remove covering from winding, if machine has been exposed to low temperature, until its temperature approaches that of the room in which it is unpacked; otherwise, sweating may result. Store machines in a clean, dry

(*Continued on page* 98)

Many RILEY Units in the I





LARGEST BOILER UNIT IN IRON AND STEEL INDUSTRY

450,000 lbs./hr. 500 lbs. Press. 750° F. Steam Temp.

RILEY STEAM GENERATING UNIT

RILEY

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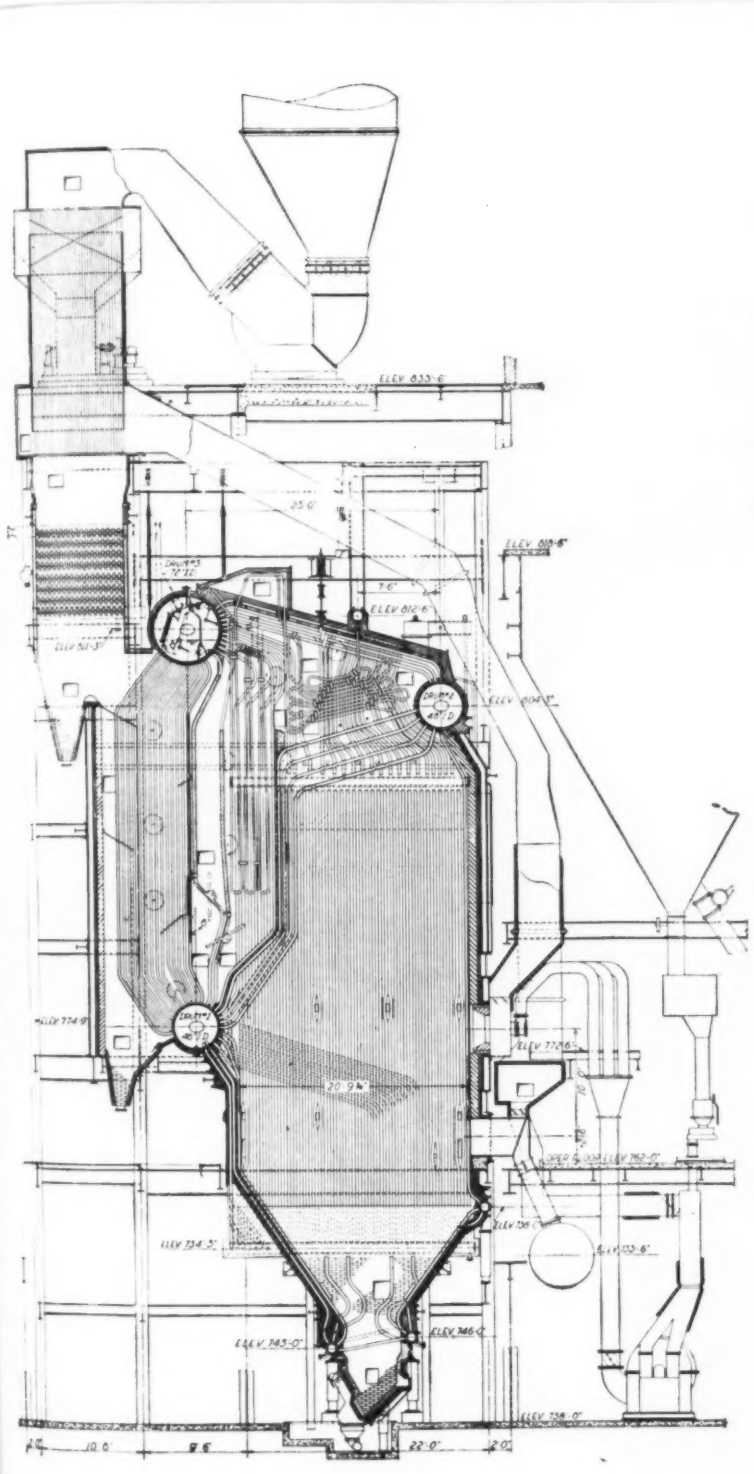
Iron and Steel Industry •



One of the largest Steel Installations made in recent years

3-300,000 lbs. hr. 750 lbs. Press. 760° F. Steam Temp.
RILEY STEAM GENERATING UNITS

Many of the more recent blast furnace gas and pulverized coal fired steam generating units are Riley Units.

In the past four years, Riley has not only sold more blast furnace gas and pulverized coal fired steam generating units than any other boiler company, but has also sold the largest unit in the entire steel industry — a 450,000 pound per hour unit, known in the industry as "the boiler" — has also installed one of the largest recent boiler installations in the steel industry — 3-300,000 pound per hour, 750 lbs. pressure, 750° F. steam temperature units.

Carnegie-Illinois Steel, Republic Steel, Colorado Fuel and Iron, Great Lakes Steel, Wisconsin Steel, Lone Star Steel—have all selected Riley Steam Generating Units in the past four years. This undisputed leadership in the iron and steel industry is additional proof of the swing to Riley Steam Generating Units.

This preference for Riley Units is found not only in the iron and steel industry, but throughout all industry. Riley installation list shows that the leaders of industry are users of Riley Units. The tremendous strides which Riley has made in the boiler industry in the past ten years is positive evidence of the quality of Riley products.

●

(*Continued from page* 95)

room if they cannot be installed as soon as received.

Location. The machine's location must meet National Board of Fire Underwriters' requirements and local regulations, and be governed by the following considerations: (1) Install so that machine is well ventilated and easily accessible for cleaning, inspection and assembly. (2) Avoid exposure to mill and coal dust, or any other injurious substances. (3) Protect machine from moisture, acid or alkali fumes.

Ventilate the motor room well so that hot air from the motor escapes and is not recirculated through it. Unless the room is large and well ventilated, natural ventilation is not sufficient. If the machine is designed to take air from the pit, provide suitable ducts in the foundation.

Foundation and erection. Make the foundation preferably of solid concrete walls or piers, carried down far enough to rest on a solid sub-base. If necessary to support the machine on steel work instead of concrete, brace the beams or girders adequately and support them by columns. Make the foundation rigid so that vibration and misalignment during operation will be held to a minimum. Pedestal-type motors depend on the foundation to maintain accurate alignment of their shaft and air gap.

Dimensions for Location

An outline drawing with each machine gives all dimensions for location and mounting. A template made to dimensions on the drawing simplifies foundation-bolt location. Provide for some variation in placing these bolts, by putting them in steel pipes embedded in the foundation, as in Fig. 1 and 2.

Roughen, clean and wash the concrete-foundation top before placing bedplate on it. A roughened surface makes a good bond between foundation and grout.

Adjust the assembled machine on the foundation by steel plates and shims beneath the bedplate until it is substantially level, and the stator air gap correct and coupling alignment satisfactory. Make these checks with the foundation bolts pulled tight after which grout bedplate to foundation.

A wooden form is best to mold the grout around the bedplate. Mix grout in proportions of one part clean sand to one part Portland cement and add water until mixture is thin enough to

(*Continued on page* 174)

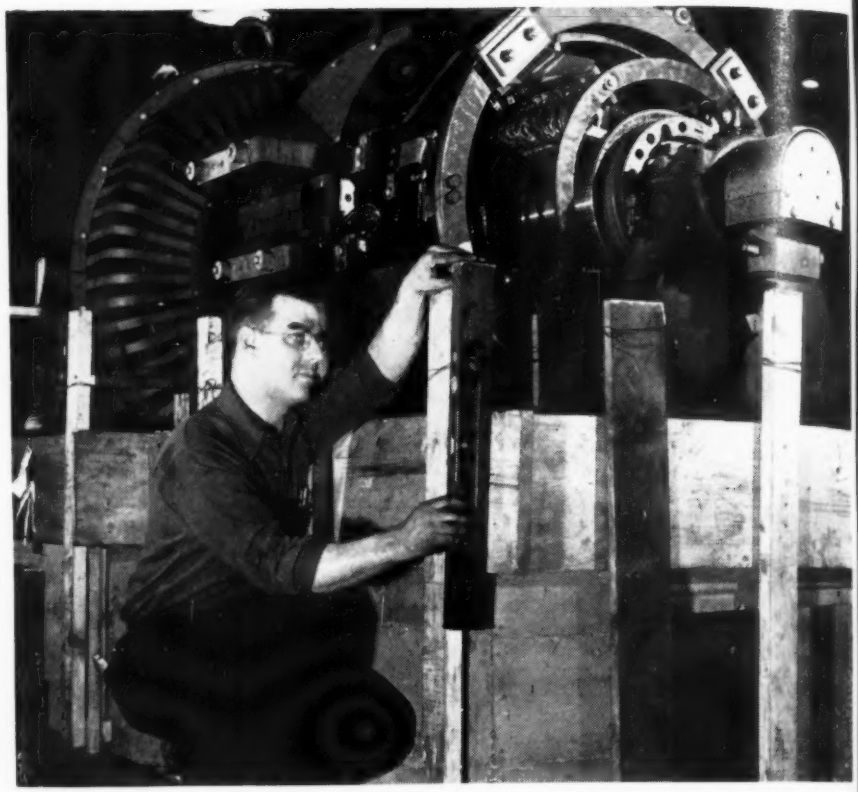


Fig. 5—Wood forms in place for pouring grout made of equal parts of clean sand and cement. Foundation top has been roughened to make good bond with the grout

Fig. 6—Pouring the grout which will bond the machine to its foundation. Add sufficient water to the grout so that the mixture is thin enough to tamp up in the bedplate

Free Enterprise

WE MUST ACT TO PRESERVE IT!

☆

LIKE a leaf floating downstream, we are being carried along toward a new and uncharted economy. What this new economy will be like will depend, to no small extent, upon what industry does or fails to do during the coming months. Time is short; in fact, we may suddenly find ourselves standing on the threshold of a peace economy with our war boots still on our feet.

While bending every effort to win the war, we cannot afford to be caught unprepared for the peace. As Prime Minister Churchill said at Harvard, we are "bound, so far as life and strength allow and without prejudice to our dominating military task, to look ahead to those days which will surely come, when we shall have finally beaten down Satan under our feet and find ourselves with other great Allies at once the masters and the servants of the future." Unless we do look ahead, there is danger that we may become neither the masters nor the servants, but merely the victims, of the future.

The war has quickened our ailing economy and opened our eyes again to the possibilities of peace-time plenty. But it has also brought great dislocations of labor and capital; it has led to abnormal patterns in prices and income distribution; and it has created inflationary pressures with enormous potential powers to injure or to help us in the transition from war to peace.

The pattern of life in postwar America will be just what we make it. All of us will have a hand in shaping that pattern, but business men will have a special responsibility in the reconstruction. As employers of labor and capital and as enterprisers assuming the risks of new ventures, they will have to plan and carry out the conversion from war work to full peace-time production. Because of their key role, business men have a special opportunity to discover, and to help others to understand, the conditions which are necessary if they are to do their job satisfactorily.

This is a narrow view of postwar problems but it is a central view, because no one condition is more vital to the health of the world than a high level of production and employment in the United States. We cannot hope to lead the world out of economic chaos if we fail to put our own house in order. If we fail to adjust our domestic economy, we may destroy Adolf Hitler; but we will not destroy the germ that breeds "Hitlers." If we do not maintain the production necessary for supporting a large volume of imports and exports, then the plans for international monetary stabilization, for good relations with our neighbors, for rehabilitation of stricken countries, and for strengthening the democratic bulwarks against dictatorship are all likely to come to grief. We must demonstrate our capacity for world leadership, or be content to follow the leadership of others.

The prospects for achieving a sound and vigorous economy in the United States are not so good as to warrant complacency on the part of men genuinely interested in free enterprise and the political freedoms incident to it. We have yet to find means to utilize our vast and abundant resources for the good of all. We have yet to learn how to keep men from the terrible experience of unemployment and the fear of want which makes them willing to sacrifice freedom and opportunity for almost any promise of security. We have yet to reconcile the conflicting interests of labor, agriculture, and business so that they can work together effectively. We have yet to learn how to check the fever of inflation and cure the palsy of depression.

When we were attacked at Pearl Harbor, we realized our physical peril immediately and united in a tremendous common effort against the enemy. The onset of economic perils is less obvious. No bombs will signal the deterioration of the private enterprise system, the extension of regimentation, the further control of busi-

ness by government, and the concentration of political power in less and less responsible hands. If these things should befall us, they will come insidiously while we are preoccupied with self interests and oriented by popular misconceptions. If the freedoms of the individual shrivel as the state grows in power, it will be because the individual is too indifferent or complacent to concern himself seriously with economic problems. If our people are misled by false prophets and demagogues, it will be because business men did not understand economics, because scholars were too ignorant of practical affairs, and because we failed to produce economic statesmen of sufficient stature for the task in hand.

Thinking is hard work. Thinking about things outside our personal experience, about economic processes that are broader and in some fundamental respects different from buying and selling or running a business — is strenuous mental labor. Thinking straight about problems that are beyond our personal and immediate status and our pocketbooks, thinking about problems that involve nation-wide production, nation-wide employment and nation-wide buying power — in other words the operation of our entire economic system — involves real self-discipline. Yet there is no other way to safeguard our freedoms. We cannot rely on trial and error; tinkering takes too long; social experiments which turn out wrong can be undone only at great cost — if at all. If we proceed blindly, we shall flounder into an economic and political morass from which we cannot escape.

We floundered badly all through the Thirties, until the war lifted us temporarily to higher ground. When the war boom is over, we shall be back floundering worse than ever unless we find a solid road along which to proceed.

America has grown rich and strong under a system of political and economic freedom. Opportunity and the necessity of self-reliance have brought forth great accomplishments. The hope of profit and the spur of competition have urged men on to find new and better products, new and better methods, and to risk their savings in pioneer investment. Never has a country achieved so high a standard of living and afforded so large an opportunity for the individual man and woman. It is not surprising that some distinguished business leaders, looking back over their own experience, tell us that everything will be all right if only there is "less government in business."

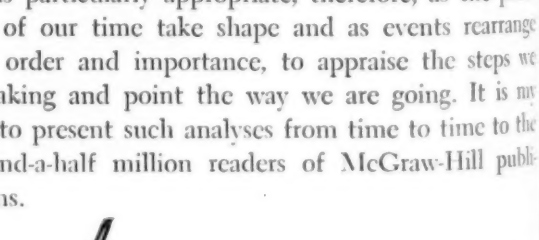
I wish the solution were as simple as that. However this is only part of the answer. It is becoming increasingly clear that industrial capitalism as we know it contains within itself certain fundamental weaknesses which can lead to its destruction if they are not counteracted. No democracy can survive when twenty to thirty per cent of its workers cannot get jobs. That happened here in the Thirties. For years on end, despite fumbling efforts at recovery one out of every five workers was denied a chance to earn a living in private business. We shall never again have such mass unemployment as occurred in the bottom of the Depression, because the government will take it upon itself to create jobs if business cannot offer them. Whenever that happens, however, the area of private enterprise will be reduced and that of government will be expanded — and the concentration of political power will be increased. This is the challenge we business men face today, and ours is the first opportunity at finding the solution.

The crux of our economic problem is unemployment. Unless there are jobs for ninety to ninety-five per cent of those who are able and willing to work, there will be widespread fear and lack of opportunity, which will drive labor unions, agricultural groups, and business interests to take self-protective measures. Such measures are certain to restrict production, stifle progress, and imperil our democratic way of life. Not all our problems will automatically be solved if we learn how to avoid mass unemployment, but they will at least then have a good chance of solution.

And so American businessmen face a great responsibility! We will have to find the answer to a great many momentous questions. We will have to delve into problems that cannot be solved by precedent.

Looking backward to these times, future historians are likely to say that here we Americans stood at the crossroads and, consciously or not, made our choice between a system of private enterprise and personal freedom and a system of collectivism and regimentation.

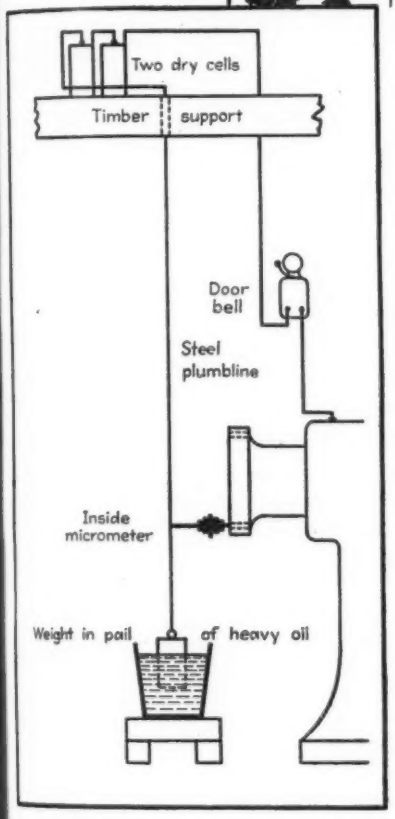
It is particularly appropriate, therefore, as the problems of our time take shape and as events rearrange their order and importance, to appraise the steps we are taking and point the way we are going. It is my plan to present such analyses from time to time to the one-and-a-half million readers of McGraw-Hill publications.



President, McGraw-Hill Publishing Company, Inc.

Once upon a time

There was an erection problem that required aligning six units, and it turned out that an ordinary doorbell laid them straight, as N L Rea, General Electric's construction wizard, recalls. And so we keep pace with progress by experience!



A chunk of iron, a pail of oil, two dry cells and a homely doorbell aided an inside mike to check the coupling face

▶NOT TOO MANY YEARS AGO, when a 500-kva machine was a big fellow and 1000 kva betokened a giant, many a millwright got by with a hank of chalkline, a homemade plumb bob, a 2-ft rule and a $2 carpenter's level. Luck and faith helped ignorance bring many a machine into line.

Speeds were low, units comparatively short, and when a shaft failed the typical fatigue break was considered prime evidence of a defective shaft forging. Too often the manufacturer was talked or bullied into replacing the shaft.

If the coupling halves stood open ten or fifteen thousandths on the bottom and touched at the top, you just put a jack under them and lifted until the faces came together, tightened the bolts, and called it a day. Some even believed in leaving the coupling open a few thousandths on top so the bolts would take some of the sag out of the shafts.

Came one day when I faced the job of lining up a 64-ft-long set with six separate units held on six bearings and joined by three couplings. It boasted a 8150-kva 50-cycle motor, a 2500-kva 25-cycle generator with load-shifting equipment, a 3500-kva dc generator and three exciters.

Crane Couldn't Handle It

To add interest, both large stators were more than the crane could handle, and the railway siding was parallel to the foundation just outside the building so that a section of wall had to be removed. Parts had to be turned 90 deg on the cars, skidded into the building and jacked onto the foundation. Figuring what pieces to ship first and how to assemble them was a jig-saw puzzle. However, this is a story only of erection and lining up.

We bolted together the various base sections and assembled bearing pedestals. Piano wire was centered between the two end bearings. We shifted base sections sideways to bring all intermediate bearings into line. Then we leveled the whole base, using a wye level and leveling target. We squared the several base sections by cross and diagonal measurements between prick-punch marks in locating plugs marked in our factory. Wye-level readings showed the difference in elevation of the machined pads.

Base structures built up by welding warp from relief of internal stresses during machining and from rough handling in shipment. So that we could tighten foundation bolts against our shims to twist and spring the base level, we put a little grout in the bottom of the bolt holes. Then the bolts held the base until all grout set solidly.

It's unbelievable how much such bases can get out of square, level and alignment, and how much you can do to bring them back to their original condition. Bases are designed to tie machinery to the foundation and should not carry any weight before being grouted in. He who thinks otherwise is asking for trouble; he'll get it, and how! It only takes one experience with troubles from this source to make the lesson stick.

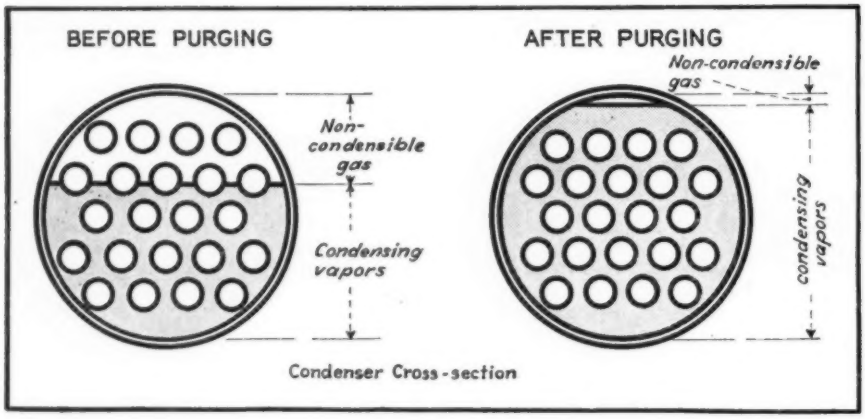
When the grout was hard enough to carry the load, we placed the motor farthest from the opening in the building wall in its bearings. We hung a plumb bob, carried by steel wire, several inches from the face of the inboard coupling on the machine's center line. Supported by wooden framework, the wire was electrically connected to the shaft through two dry cells and an ordinary doorbell. The 10-lb weight hung in a bucket of heavy oil to damp out swinging. We adjusted an inside micrometer so the bell just tinkled as it made contact between coupling face and wire (this is much more accurate than feel or sight, and gives results within a mil).

Then we adjusted the outboard bearing by shims between bearing pedestal and base until coupling face was exactly parallel with plumb line. As a check, we moved plumb line to outboard coupling, which was found to toe in at the top several mils; this checked the calculated shaft deflection within a mil.

Second Unit Adjusted

The second large unit was then adjusted by feelers until its half of the coupling was parallel to the first half. After bolting this coupling, we worked both ways from the two large units, setting each half coupling parallel to the half already in place. Each stator, or stationary field, was centered in its rotor or armature, both along the shaft and radially. This gave us a series of catenary curves with each shaft having its own deflection and without misalignment strain on shaft, coupling or coupling bolts. End bearings were considerably higher than those between the two large units, *as they should be.*

Combined revolving weight was over 200 tons, yet five men could easily turn the rotor when we applied starting oil pressure to the bearings. Coasting time was over an hour when we cut off power. End play was fine. Our reward was the customer's simple comment, "It pays to be fussy."



Permitting non-condensible gas to exist in the condenser not only increases the compressor's work but also reduces active tube surface contacting the vapor

Keep That Head Pressure Down

Here's how refrigerating engineers can lower their over-all power costs or reduce fuel consumption. John D Constance gives figures that show how high pressures waste power

► ABNORMALLY HIGH condensing pressure is one of the commonest causes of inefficient refrigerating plant performance. Gages that register pressure accurately must be installed as plant equipment before an engineer can operate intelligently. Then he can keep head pressure down to a level that promotes highest efficiency for his type of compressor.

With reciprocating compressors, for example, system economy in power and water is usually of prime importance, although at times economy may be sacrificed when maintaining relatively low head pressure to prevent compressor overload.

Centrifugal compressors, on the other hand, present a different problem: Important factor here is to maintain head pressure low enough to insure good compression. Pressure that is allowed to go too high destroys all refrigerating effect.

Permitting system condensing pressures to exceed normal value by a wide margin decreases compressor capacity, increases power consumption and plant maintenance. The following example illustrates effect of high pressures:

In a 20-ton-capacity plant, with compressor operating normally at 20-psi suction and 185-psi condensing pressure, ammonia is the refrigerating agent. Under such conditions, compressor should develop about 19.2 tons of refrigeration with about 31 bhp. Overall motor efficiency of 80% would require a 40-hp motor. Assuming a power rate of 2 cents per kwh, the power bill (exclusive of demand charges) would be $10.40 per 18-hr day. With other conditions constant, permitting condensing pressure to increase to 225 psi would lower compressor capacity to 17.9 tons, a decrease of 1.3 tons. Increase in power cost accompanies decrease in tonnage, since horsepower required to drive the compressor jumps to 34.5 bhp, an increase of 3.5 hp. Power cost would then be $11.60 per 18-hr day, or $1.20 per day higher. Assuming compressor runs 30 days a month, power would cost $36 more a month.

With such capacity loss the work, which normally can be done in 18 hr, now requires 18 x 19.2/17.9, or 19.25 hr. We are not only throwing away $36 above the normal power bill, but have lost and must account for 1.3 tons of refrigeration. This again increases power cost, for now operation must be 34.5 bhp per day of 19.25 hr, resulting in a daily cost of $12.40, which is $2 a day higher than normal. Running 30 days a month would bring cost to $60 in excess of normal monthly bill.

Consider the problem further. The foregoing accounts for power cost only; if we go further and project the 1 hr and 15 min additional working time into labor, delay and other actual costs, we see how wasteful excessive head pressure is.

The figures clearly illustrate the price the owner pays for permitting this condition. And, remember, the larger the plant, the higher the cost of inefficient operation. In the above example the motor is a single 40-hp compressor one; to reduce operating costs all compressors in a plant must receive similar attention.

Generally, excessive condensing pressure can be reduced easily; however, some plants might require more condensing surface, or more and cooler condensing water. Usual causes of excessive pressure are: non-condensible gas in the system and/or dirty condensers. Non-condensible gas accumulates from day to day; machines often operate at a vacuum and pull air into the system around the shaft packing or other leaks.

Dirty Condensers

Condensers become dirty from two main causes: (1) Scale is formed inside the tubes by hard or scale-forming cooling water. (Ground or surface water, which varies in hardness from one section of the country to the other, deposits large quantities of scale quickly in some localities; in other sections it does not deposit scale readily

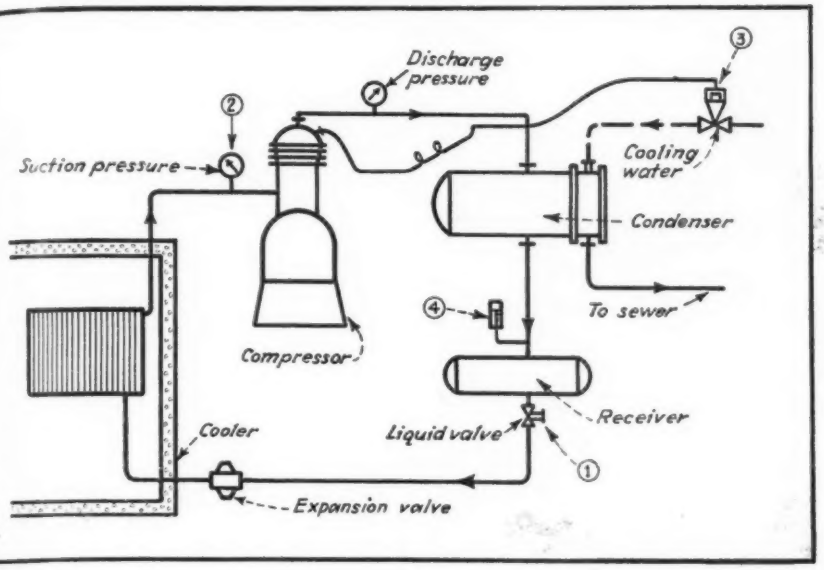
TIPS ON HEAD PRESSURE

High head pressure indicates:

1. Non-condensible gas in system
2. Dirty condensers
3. Lack of condensing water
4. Condensing water that is not cool enough
5. Lack of sufficient condensing surface to do the job

Low condensing pressure shows:

1. Increase in plant capacity
2. Decrease in power consumption
3. Longer refrigerant life comes from lower prevailing temperatures and pressures
4. Less wear and tear on the compressor and motor



and hence condensers do not become dirty so quickly). (2) Trash and dirt that blows into the cooling tower settles in the cooling tower pan. Inspect and clean the pan periodically. Bleeding a small amount of cooling water off the system reduces accumulated salt concentration and scaling compounds.

A few rule-of-thumb methods determine whether non-condensible gas, dirty condensers, lack of cooling water, or lack of condensing surface causes high head pressure. Best time to check for non-condensible gas (including air) is immediately before starting the refrigerating system or after a shutdown. Operation is simple and should, therefore, be routine plant procedure.

To check an air-cooled Freon-12 condensing unit for non-condensible gas, first see that the system contains a full charge of refrigerant; condenser outlet must be sealed by the liquid. Next, close receiver-liquid outlet valve and stop compressor. Close suction stop valve immediately. Then, attach an accurately calibrated service gage to the compressor discharge and open its valve. Suspend a thermometer in the air near the condenser, but away from outside heat source and wait until condenser has cooled to room temperature or until discharge pressure shows no further decrease. Read the air temperature near the condenser. It is the actual liquid Freon-12 condensing temperature applied to the condenser. Check this against the true condensing temperature shown in red on the pressure gage. A differential of 5 F indicates need for purging.

At first, this method of determining whether the condenser needs purging may not sound simple; however, every plant has a suction and high-pressure gage. Many others also have a thermometer well in the receiver liquid line. In plants not equipped with liquid-line thermometer wells the operator by simply beginning to purge the condensers tells whether or not purging is necessary. The method, of course, is not so efficient as the one previously outlined; nevertheless, it can be and is used in many plants.

Condensers and receivers usually carry valved taps for a purging connection. Attach a hose to the tap and immerse the free end in a pail of cold water (It absorbs ammonia readily).

To purge an ammonia system, run condensing water through the condenser until liquid ammonia temperature shows no further decrease—this takes from 15 to 20 min. Slowly release the gas through the purge valve into the pail of water. Gas bubbles rise to the water surface. Escape of ammonia vapor causes a loud cracking sound as it is absorbed by the water. Continue to purge until all bubbles disappear. Water absorbs fumes given off by non-condensible gas and, therefore, must be renewed frequently. Hand purging always wastes a small amount of ammonia.

A non-condensible gas separator, which discharges only the gas, purges more economically. It condenses and returns ammonia vapor to the system. With experienced operators some hand-operated gas separators are not so wasteful of refrigerant; however, the automatic separator is far superior because it functions without attention other than an occasional change of water in the glass jug into which the gas discharges.

As dirt or scale accumulates in the water side of the condenser, water flow must increase to prevent undue condensing pressure rise. Keeping accurate temperature records once the condenser has been cleaned, or when it is new, shows when heat transfer begins to fall off. As a basis for comparison, check temperature of condensing water both before it enters and after it leaves the condenser, during normal operation. Suspect dirty condenser tubes only after purging fails to restore normal head pressure.

Condenser Performance

To obtain an over-all check on condenser performance, proceed as follows: Read condensing temperature corresponding to condenser pressure and then water temperature as it leaves condenser. Subtract water temperature from condensing temperature. When the difference is 4 or 5 F above what it is on a new condenser or one freshly cleaned, remove the accumulated sludge.

When preparing to clean the condenser, use extreme care in removing water connections and water heads and don't injure the rubber gaskets in any way. Ammonia condensers use steel tubes while those for Freon-12 use tubes of copper or copper alloy. Connect a water hose to the tube-cleaner pipe and drill a few small holes in the pipe just behind the cleaner. Water admitted to the working area prevents clogging and flushes away dirt and scale. Use a dilute solution of muriatic

(*Continued on page* 140)

PURGING CHECK TEST

1. Close receiver-liquid outlet valve
2. Continue compressor operation until normal suction pressure decreases about 10 psi
3. Block open condenser water supply valve and shut down compressor
4. Continue water flow until high-pressure gage and liquid ammonia temperature show no decrease
5. Check pressure and temperature against figures shown in red on ammonia pressure gage
6. Ammonia temperature lower than 3 F below that shown on the red scale indicates need for purging

British Information Service

Air views of damage to Moehne Dam. Breach is 250 ft wide, 42 ft deep, according to recorded dimensions. Loss of stored water, vital to plants and navigation facilities below, is clear. Main power station in front of dam appears destroyed

Real Reasons for Astounding Success of RAF's Low-Level Attacks on German Dams

▶ TECHNICAL PLANS for bombing the Moehne and Eder dams last May were based upon experience gained in an abortive attack on an Italian dam many months ago, according to data from the British Information Service. Torpedoes were used by these missiles did not carry sufficient explosives. Moreover, the Germans mounted torpedo nets across the face of dams and increased anti-aircraft protection, particularly against low-flying planes.

Experts decided that the only way to force a breach in the dams was to supply a series of rapid and heavy high-explosive pushes *under water*. The missile decided on was the sea mine because it has a greater weight of explosive in proportion to the weight of the case than does a bomb.

"Planning the attack involved very onerous decisions," the report continues. "It was seen, for instance, that only a *very* low-level attack would have much chance of success. In actual fact, Wing-Commander Gibson, V.C., D.S.O., D.F.C., who led the flight, went in at only twenty feet above water level. And most of the following aircraft went in at this height.

"Such a plan involved the attacking forces in two great hazards. It was known that a large concentration of low flak had been mounted in the dam towers and on the banks, and thus the aircraft would have to meet a tremendous amount of virtually point-blank fire. Also, such a low-level attack exposed the aircraft to heavy risks of blast from the exploding mines. It is believed that some of the eight missing bombers were, in fact, destroyed by this cause. (There is a story, not from official sources, that one Lancaster was seen caught on an upflung tower of water a hundred feet high—just like one of those jet-suspended balls in a shooting gallery—and flung like a toy airplane into the lake.)

"The crews who went knew all about those hazards and accepted them fully. Split-second timing of the assault by each aircraft was also necessary if the required explosive force was to be exerted and the operation have a chance of success. And the utmost precision in aiming the mine was necessary [illegible] that they would slap up against the face of each dam. No easy matter for an aircraft flying at about 300 miles an hour in the face of withering fire.

"So at an English aerodrome the selected aircrews with the bombers they would use went into endless practices and rehearsals. They practiced till every man, from the gunners who would have to put up a blanket of fire against the defenses, to the pilots and bombardiers, knew their jobs to a hair's breadth. They practiced till each aircraft could drop its dummy mine between a pair of rugby goal-posts beneath the crossbar, and in line with the posts.

"There lie the real reasons for the astounding success of this desperate venture. First, the most meticulous planning and timing. Second, sheer perfection in practice and training. And only third, the fortitude of the crews who did the job. For without the first two factors all the courage in the world would have been of no avail."

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Rx For Making Good Chain Drives Better by A-1 Lubrication

C J Copley, lubrication consultant, divides chain drives into classes according to their speed and gives easy-to-remember rules for the right lubricant, in the right place, at the right time, by the right method

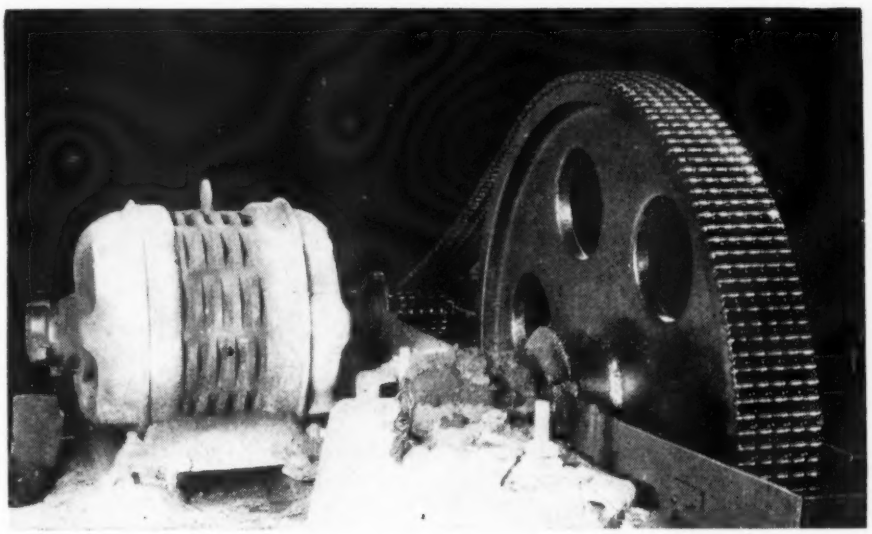
Method and Kind of Lubrication for Various Types of Chains

Type of chain and operating conditions	*Lubrication method*	*Lubrication viscosity, SSU*
Cast or Forged Links		
Chain runs open	Hand	1000 at 210 F or semi-fluid aluminum-soap-base grease
Chain inclosed in oil-tight case	Splash or bath	600 at 100 F
Roller or Silent Chain		
Slow speed	Splash or bath	325 at 100 F
Medium and high speed	1. Drip or drop feed	600 at 100 F
	2. Ring or disk oilers: forced circulation and wave lubrication	325 at 100 F

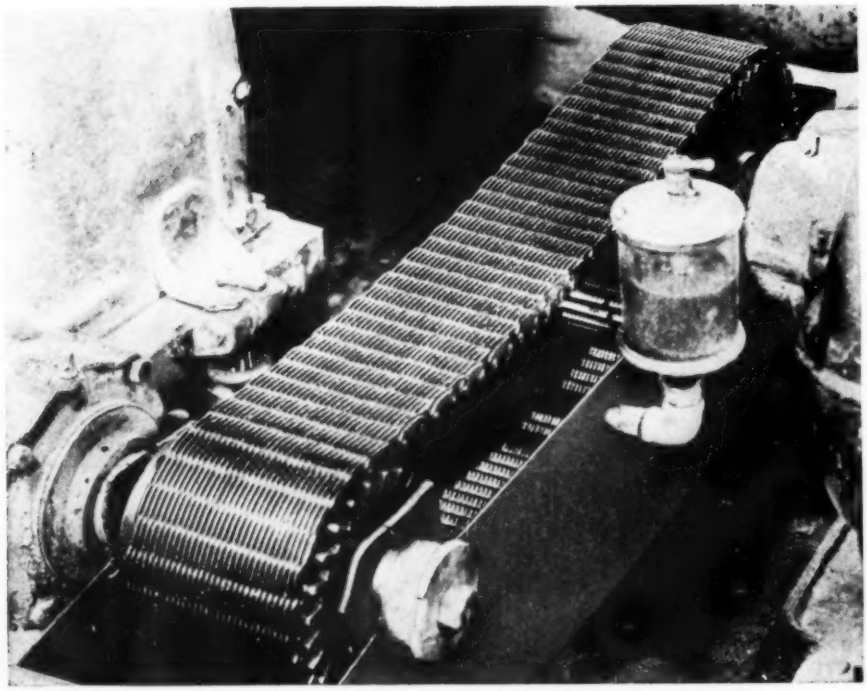
NO SINGLE FACTOR gives greater dollar-value return in chain-drive service than does proper lubrication because it has a direct relationship to chain wear and, hence, to chain life. For all practical purposes, selection depends on type of chain, its speed and how lubricant is applied. Size of chain, how heavily it is loaded and atmospheric conditions may also influence selection.

Three basic chain drives are in general service: (a) chains of cast or forged links, Fig. 1 and 2; (b) finished-steel roller chains on cut-tooth sprockets, Fig. 3; and (c) silent chains on cut-tooth sprockets, Fig. 4.

Cast- or forged-link chains do not present serious lubrication problems. The links assume many shapes, designed to operate conveyor or auxiliary equipment rather than primary power transmission. Bearing surfaces are for slow-speed operation up to about 500 fpm. Normally applied by hand with



Complete inclosure protects 5-strand ¾-in.-pitch roller chain from grit and makes it easy to lubricate while transmitting 20 hp from 1160-rpm motor



Drip feed from casing cup lubricates 5-in. silent chain, operating at 5030 fpm and connecting 75-hp 1750 rpm motor to hammermill to grind wood shavings. Other methods of lubricating high-speed chains include ring, disk and circulating systems

brush or paddle, the lubricant should be a viscous, adhesive product of about 1000 SSU at 210 F. Good practice requires application once every 8 hr of operation—oftener if chain shows signs of dry spots.

When the chain runs in an oil-tight case, bath lubrication may be used by letting lowest point of chain run in an SAE 40 engine oil. If operating temperatures are likely to drop below 32 F, see that oil remains fluid and flows to chain. If oil gets so thick that it channels, add sufficient kerosene to keep it fluid temporarily, and replace it when temperature returns to normal.

Roller- or silent-chain drives, made up of precision-machined links and assembled with close clearances between pins and bushings, are particularly responsive to proper lubrication. Whenever possible, use a light oil that penetrates into the close clearances and yet has enough body to form a film on the finely machined parts to protect them against undue wear.

When service conditions, restricted installation space or other factors exclude use of oil-tight inclosing cases for chain speeds below 500 fpm, use a semi-fluid highly adhesive grease. Because of their adhesive characteristic, aluminum-soap-base greases are preferable to lime-soap-base greases. Apply frequently to inside of chain a grease of soft consistency that tends to work outward through link bushings and between rollers and pins. Take care not to let the chain run dry.

Slow-Speed Chains

If chain speed does not exceed 500 fpm, slow-speed roller and silent chains in oil-tight cases can be lubricated by either of these methods:

(1) *Drop oil on chain with sight-feed oilers.* Set sight-cup oilers to supply two or three drops of lubricant, per minute per inch of chain width, directly to inside of lower strand. If oil drops on outside of chain, centrifugal

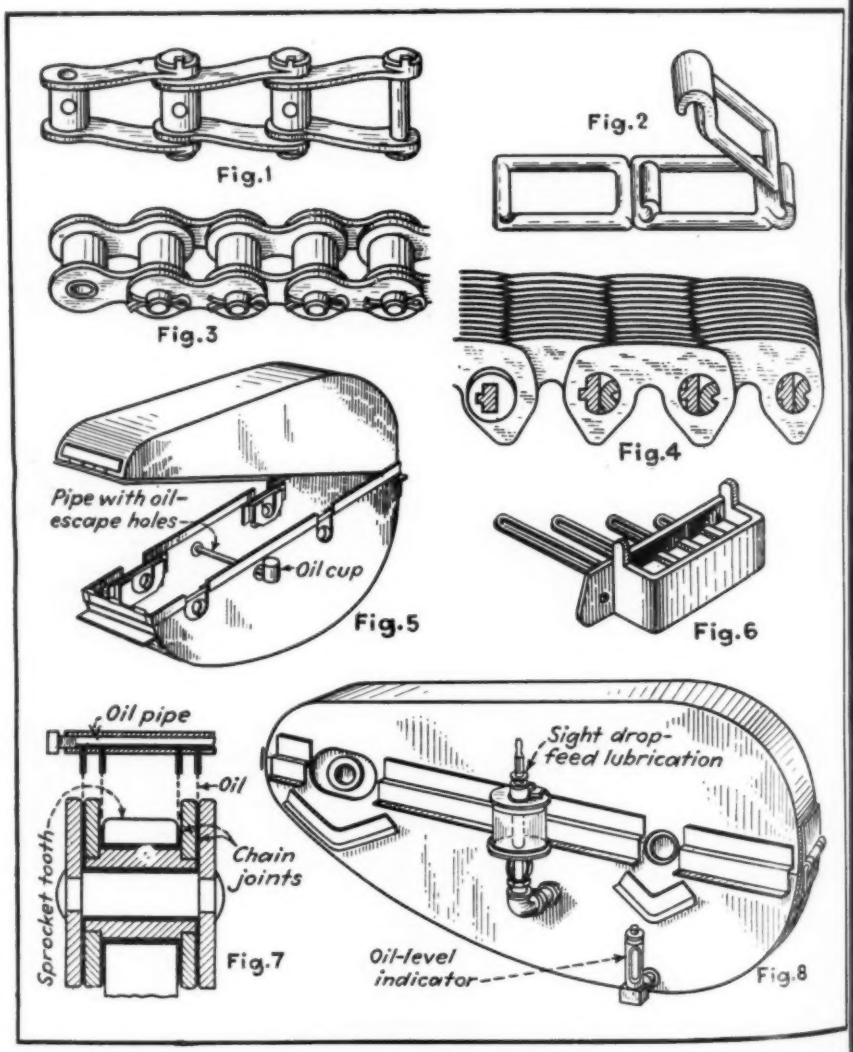


Fig. 1—Closed-end pintle chain uses malleable-iron cast links. Fig. 2—Detachable-link chain with malleable-iron links. Fig. 3—Single-strand finished-steel roller chain. Fig. 4—Section of silent chain. Fig. 5—Drip lubricator has oil cup on side of casing with drip pipe above lower strand of chain. Fig. 6—Multiple drip oiler for large chains. Fig. 7—Oiler drops lubricant between side plates of roller chain and between side plates and sprocket teeth. Fig. 8—Drip lubricator supplied from drop sight feeder

force tends to throw it off before much lubrication occurs.

(2) *Dip chain into an oil bath.* Do not permit oil level to rise more than ½ in. above chain's lowest point in bath lubrication or excessive oil agitation may result.

For bath of slow-speed chains, use a light-bodied oil of about 325 SSU viscosity at 100 F. For drip, wick or sight-feed oilers, use a somewhat heavier-bodied oil of about 600 SSU at 100 F, since application is not continuous.

Fig. 5 to 8 show some of the methods other than bath lubrication for applying oil to slow-speed chains:

The oiler in Fig. 5 is a pipe extending across inner face of chain's lower strand. A cup outside the casing feeds oil to the pipe, from which it drips through holes onto the chain. For speeds below 500 fpm, the oil cup may be replaced by a grease fitting, and the chain lubricated with a grease gun.

In the multiple oiler for large chains, Fig. 6, different-length pipes lead out over the chain from separate reservoirs, each of which has loose waste wadding at its end to regulate the lubricant flow.

The oiler, Fig. 7, directs oil to wearing surfaces of roller chains by dropping it into the joints, both between side plates and between side plates and sprocket teeth.

A sight-feed lubricator, Fig. 8, mounted outside the inclosing case, is adjusted to deliver a few drops of oil per minute to the inside face of the chain's lower strand. An overflow sight gage, which shows height of waste oil in the case, is set so that oil overflows when it rises more than ½ in. above bottom edge of sprocket.

High-Speed Chains

Do not use grease for chains operating above 500 fpm because sufficient lubricant must continuously reach clearances between pins and bushings or between rollers. Excessive oil agitation resulting from the high speed at which the chain travels makes it necessary to use other methods than ordinary bath or splash lubrication.

When chains travel through an oil bath in excess of 1000 fpm, fluid friction heats the oil excessively and may produce an air pressure in the inclosing case that causes oil leakage in spite of the best sealing methods.

In addition to the drip oilers described in Fig. 5 to 8, moderate- and high-speed chains are lubricated by ring and disk oilers and by controlled bath lubrication, Fig. 9 to 11, as follows:

The large-diameter oil ring, Fig. 9, hangs on the shaft beside the chain and dips into the oil reservoir. When the shaft turns the ring, oil that adheres to it is scraped off into a trough and diverted through a pipe to inside of chain. Always install ring at slow-speed sprocket.

The disk oiler, in Fig. 10, picks up oil from the reservoir and throws it against the baffles. From there it runs into troughs that deliver it to the inner surface of the chain's bottom strand.

In the controlled bath, Fig. 11, the constant-level oiler maintains oil level just high enough for shallow dipping of chain link plates at lower sprocket.

(*Continued on page* 136)

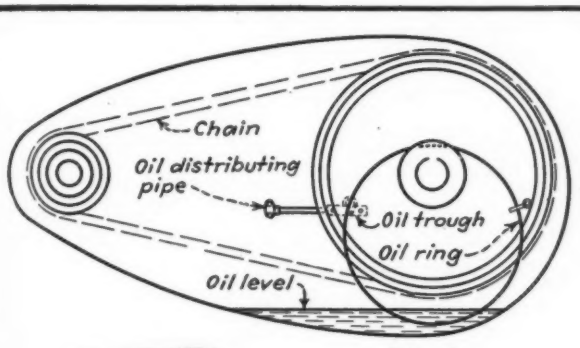


Fig. 9

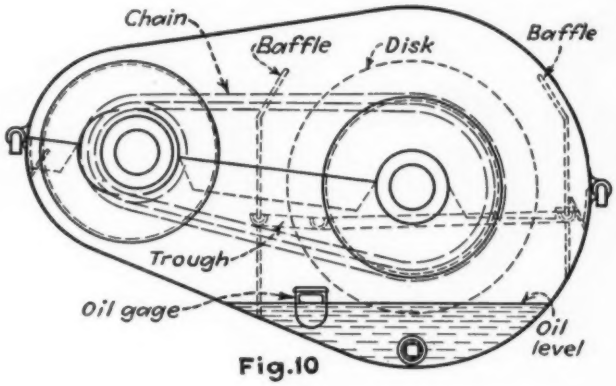


Fig. 10

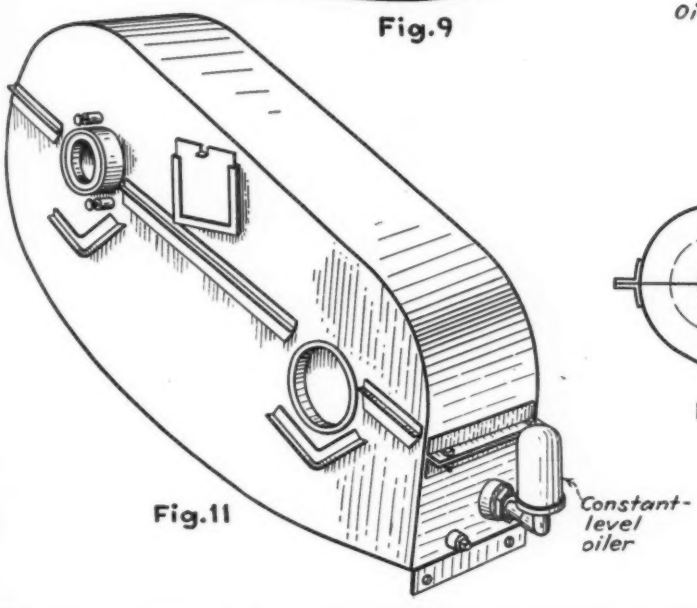


Fig. 11

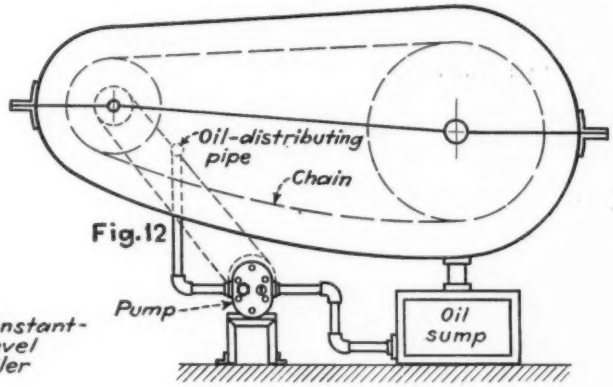
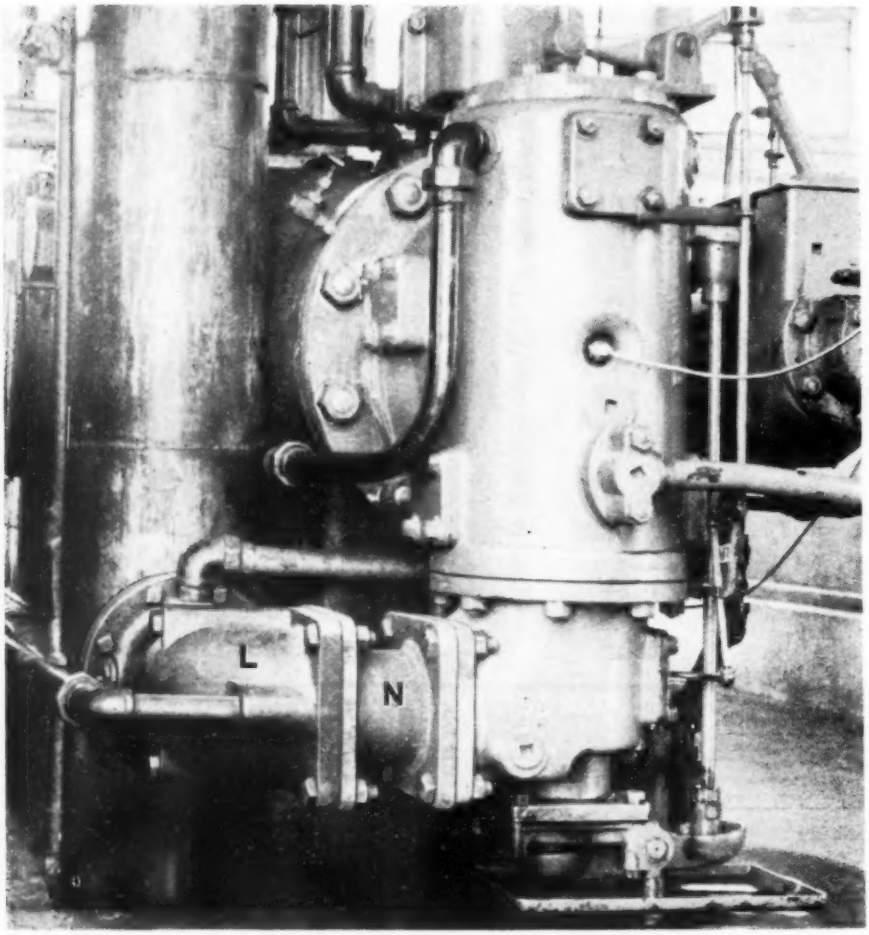


Fig. 12

Fig. 9—Ring automatic oiler operates on principle of ring-oiled bearing. Fig. 10—Disk throws oil on baffles that direct it onto chain. Fig. 11—Constant-level oiler maintains oil level just high enough for shallow dipping of chain link plates at bottom of lower sprocket. Fig. 12—Motor-driven pump circulates oil and sprays it on chain under pressure; oil then returns to sump.

PRACTICAL AIDS TO OPERATION



Changes Horizontal to Vertical Exhaust Lines

A NUMBER OF GAS ENGINES were being installed where everything was arranged to take the exhaust pipes outside the building in ground trenches and then to mufflers. An exhaust line in an earth trench is subject to damage by corrosion. To avoid this condition it was decided to run these lines to the plant roof and there connect them with their mufflers. The photograph shows how this change was made.

Flanged nipples *N* were installed on the exhaust valve cages to extend the water jacketed ells *L* to the point where the vertical exhaust pipes would clear the engine cylinders. The water-cooled ells were placed in a horizontal position facing back toward the engine and connected to elbows facing upward for the exhaust pipes. This placed the exhaust pipes near the engine cylinders away from the exhaust-valve cage.

A triangular support on each engine foundation at the inside corner of the bedplate takes the weight of the exhaust pipe off the exhaust-valve cages and water-cooled ells. Cooling water was piped to the exhaust ells as originally planned to keep their temperature within reasonable limits.

Light-weight-steel shells enclose the vertical exhaust pipes, with space between coverings and pipes for air circulation to carry heat from the pipes to the roof and to protect operators from accidental burns. This arrangement has been successful and placed all parts of the equipment where they can be readily inspected.

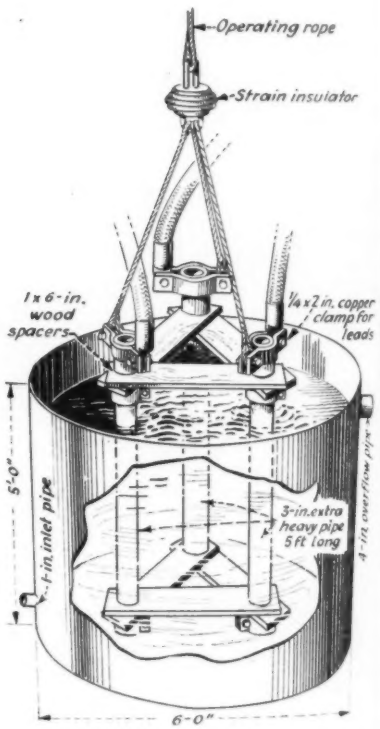
Santa Monica, Calif. J C ALBRIGHT

Artificial-Load Rheostat

THE RHEOSTAT SHOWN in the drawing was designed to provide a test load on a 1500-hp diesel engine driving a 1,000-kw, 3-phase, 60-cycle, 2300-v alternator. When making load tests, full load is not likely to be carried for long periods, so it is not necessary to design a rheostat for continuous service. In the figure the rheostat tank holds approximately 90 cu ft of water. Any tank approximately 6 ft in diameter by about 5 ft deep can be used with electrodes made up of 3-in. diameter or larger pipe. Extra-heavy pipe is preferred in 5-ft lengths arranged in a triangle.

The pipes are positioned by 1x6-in. wood spacers with holes through their ends to fit the pipes snugly and hold them 2 ft apart. Iron clamps hold the spacers in position on the pipes.

Three clamps made of ¼x2-in. copper connects the load leads to the pipe tops. Three ropes running from the clamps to a strain insulator support the electrode assembly. The insulator serves to insulate the operating rope and protect the operator. Select an insulator



rated 2500 volts or higher and locate it far enough above water to keep it dry. Run the operating rope over a pulley and tie it to some convenient anchor.

Provide a 1-in. inlet pipe near the bottom of the tank for a hose connection to a water supply and a 4-in. outlet pipe for overflow.

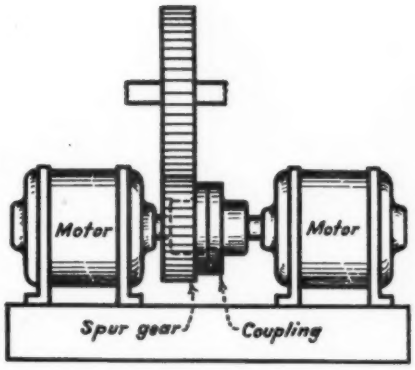
If the permanent switchboard cannot be used when making the tests, it is advisable to include an automatic circuit breaker in the load circuit, mounted temporarily for protection. For further

protection, connect the generator field coils in series with a rheostat that will permit regulating the generator voltage from a low to full value. Thus, in case of trouble, generator voltage can be dropped quickly. Provide an ammeter and voltmeter in the load circuit. With this water rheostat, generator load may be changed in three ways: (1) by raising or lowering electrodes, (2) by varying the amount of salt in the solution and (3) by varying the generator voltage with the field rheostat. The service department has used similar water rheostats for many years with good results.

East Pittsburgh, Pa. ELMER SIMPSON
Electric Service Engineer
Westinghouse Electric & Mfg Co

Two Motors Solve Multispeed Problem

RECENTLY I was called in when trouble developed in a 7.5-hp squirrel-cage



motor with a double stator winding. One winding could be grouped for either 600 or 1200 rpm, and the other winding connected for either 900 or 1800 rpm. Fire had started in the motor windings which had become soaked with lubricating oil and improper use of a soda-ash fire extinguisher. The motor required a complete rewind, a job that the plant was not equipped to do.

Trouble developed Saturday and the motor was needed Monday. It was impossible to get the motor rewound and telephone inquiries over a wide area failed to locate a similar motor. After inquiry about the drive, I found that two speeds would do: 1200 rpm in one direction and 900 rpm forward and reverse. Accordingly, I removed the gear from the damaged motor, started shopping and located two motors of the desired speed: one, a 5-hp 1200-rpm. and the other, a 3-hp 900-rpm unit.

Problem of connecting the gear to the two motors was solved by boring out the gear and mounting it on one half of a flexible coupling, which I keyed to one motor shaft. The other half of the coupling was keyed to the other motor shaft and the two motors coupled together, as sketched.

I rewired the 4-speed remote control to give two speeds forward and one reverse. By Monday morning the machine was ready for operation at a cost not exceeding that for a rewind job on the damaged motor.

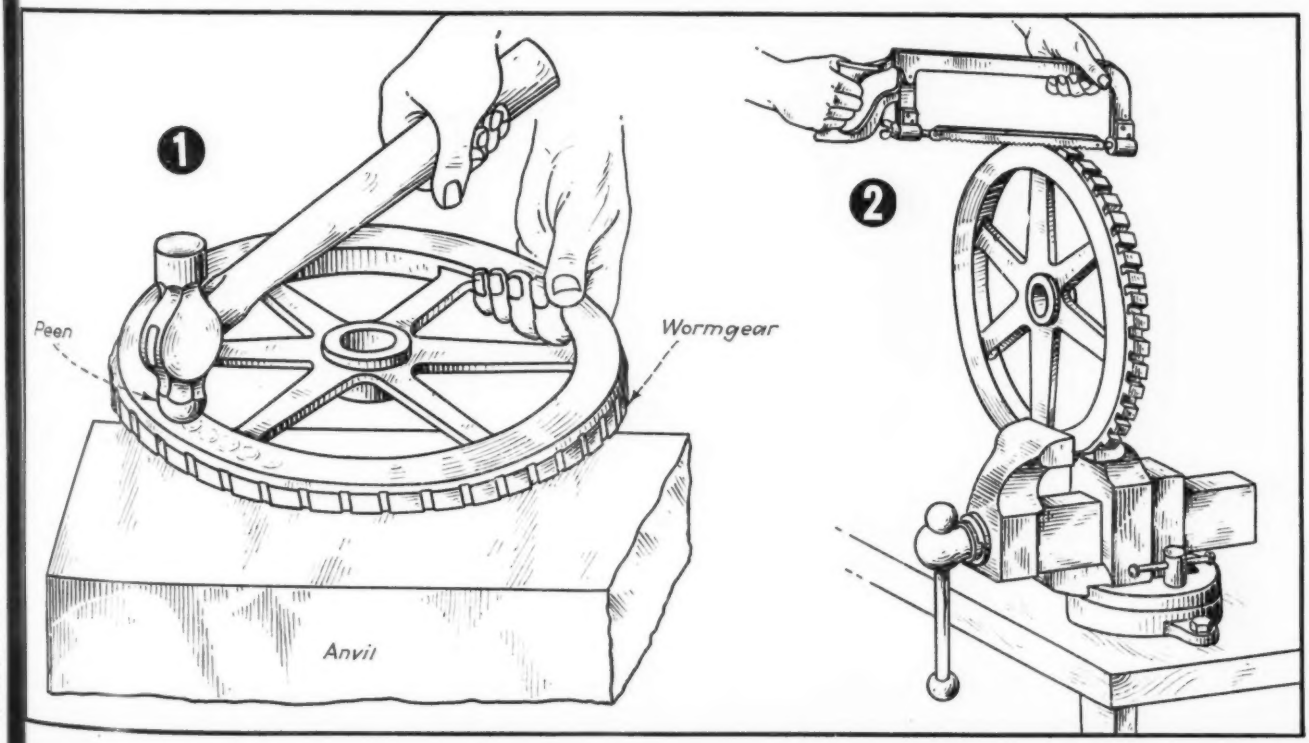
Schenectady, N. Y.
CARL BACHMANN

Cuts New Teeth in Worm Gear Wheel

ALL THE TEETH stripped on the worm-gear in our turbine-lubricating-oil purifier. It was necessary to operate the purifier for the turbine and the reduction-gear oil, but we could not get a new gear for at least two months. The worm was steel and the gear brass, so we decided to expand the wheel to where we could cut new teeth on it.

We placed the rim of the wheel on an anvil, Fig. 1, and peened each side of it with a ball-peen hammer. We did this until the outside diameter of the gear had increased ¼ in. After placing the gear in a vise, Fig. 2, we cut new teeth in it with a hacksaw. By using two blades in parallel, the proper width between teeth could be cut in one operation.

Enough of the original teeth remained on the gear rim to serve as guides to cut the new teeth. After the cuts were made with the saw the rough teeth were finished with a thin file.

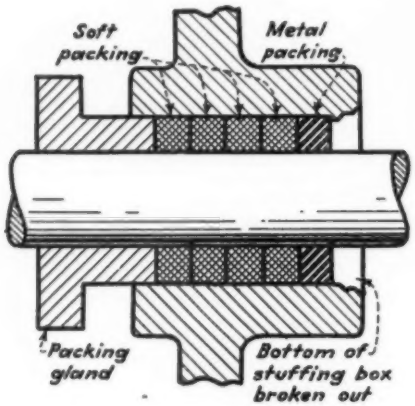


This gear worked so well that we operated eight months before the new one was installed. Even then, when the repaired gear was removed it showed no signs of wear.

Great Neck, N. Y. S M ELONKA

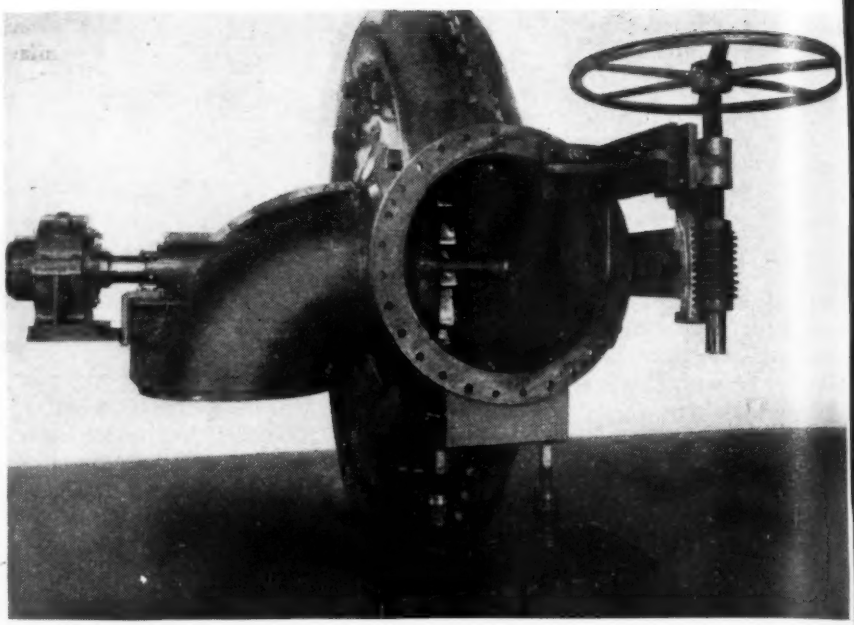
Metallic Packing Repairs Pump Stuffing Box

A SIMPLE REMEDY eliminated constant trouble with packing in the stuffing box on the water end of a boiler-feed pump. Part of bottom of box had been broken through by careless packing so that any



packing in the stuffing box was soon pushed into the water cylinder. We could not get a new head with a stuffing for the pump, and facilities were not available for repairing the old one. To correct this we placed a ring of hard-metal packing in bottom of box, as in the figure. We placed regular grade of soft packing against this ring and tightened it in place with the gland. This has worked so successfully that we will probably not repair the pump for the duration.

Springfield Gardens, N. Y.
E L O'BRIEN



Rebuilding Increases Waterwheel Output

OBSOLETE WATERWHEELS often can be rebuilt to give a large increase in power, as we did with two units in the Parker-Young plant at Lincoln, N. H. Photo shows one of the rebuilt units, in which we installed new runners. The old cast-iron casings were rebored and equipped with new bronze gates and new roller thrust and radial bearings.

As a result, power output increased 20%. In addition, the changes eliminated frequent trouble and maintenance expense caused by the old thrust bearings not properly supporting the runners. Our experience shows that increase in power output from remodeling old waterwheels often pays modernization cost in a short time.

Orange, Mass. CARL C HARRIS
Rodney Hunt Machine Co

Rapid Retardation Causes Wire Rope Failure

UNUSUAL WIRE-ROPE FAILURES were discovered recently on two 5-ton skip hoists, after 9 months' service in a power plant. The hoists operated in adjacent 250-ft hoistways, at a 45-deg angle. Buckets and counterweights each had a single 1-in. 6x9 plow-steel rope, with a rated breaking strength of 81,600 lb. Head sheaves were 30 in. in diameter, and the drum 36 in. Calculated tension in the bucket ropes was about 13,500 lb.

Many broken wires were found inside the hoist and counterweight ropes. All ropes showed no wear on the outside wires. Broken wires in the counter-weight ropes were concentrated within a length of about 2 ft about 65 ft from the drum when the counterweights were at their lowest position. This point was about 25 ft down the hoistway from the 30-in. head sheave. Another bad area existed near the lower end of the counterweight ropes.

To determine the cause of the damage to the ropes one of the hoists was operated under close observation. It was noticed that shortly after the counterweight started upward from the hoistway bottom, when the rope had an unsupported span of 250 ft, a slight whipping action occurred, as observed from a platform below the head sheave. Shiny ends of broken wires as they passed through the field of vision at 450 fpm produced bright streaks in an otherwise dark rope. As the counterweight ascended these streaks assumed the form of several overlapping sine waves, which became shorted but of increasing magnitude until they became a perfect sine wave. At this instant slowdown occurred with a severe jerk when the lower bad spot in the rope was passing over the head sheave.

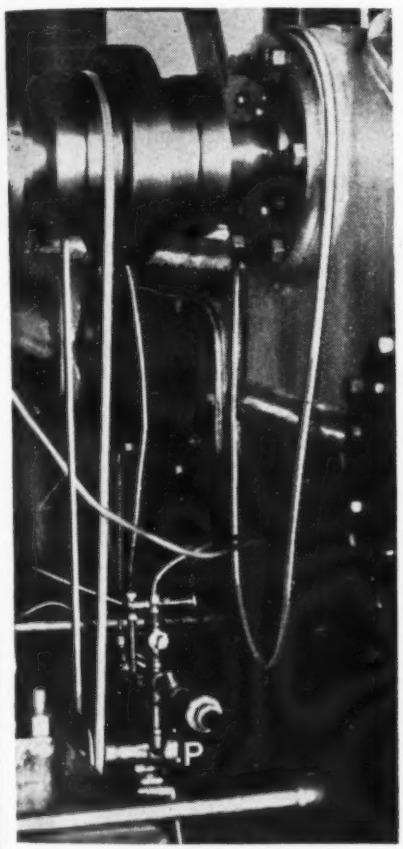
Inspection of the motor control showed that the three accelerating contactors closed in sequence to bring the motor to full speed in about 7 sec. This rate of acceleration, although rapid, was reasonably smooth. On slowdown, however, contactors 3 and 2 dropped out simultaneously, slowing down the hoist from 450 to 150 fpm so rapidly that the counterweight or the bucket, depending on the hoist motion, continued to ascend by its own inertia. This caused a slackening of the rope which was taken up with a severe jerk and violent whipping of the rope. Severe strains put in the rope during stopping also wore deep grooves in the drum and head sheave.

When the ropes were removed from the hoist a large number of broken wires previously unnoticed worked out. They had been cut by wires that crossed them in adjacent strands, when the rope was under excessive tension during stopping of the hoist. Undoubtedly the ropes were being severely over-

loaded during acceleration and retardation of the hoist.

To correct this condition we first properly conditioned the drum and sheave grooves, then installed new ropes and adjusted the controller contacts to retard the hoist in three steps instead of two. The latter stopped the whipping of the ropes and prevented the severe stresses produced in them by the previous method of operation.

Chicago, Ill. J B MULLINS



Drives Oil Pump From Engine Coupling

IN ONE PLANT a standby lubricating-oil circulating pump was needed on an engine, connected through a flexible coupling to a power-driven reciprocating pump. This problem was easily solved by mounting the pump on a bracket attached to the engine bedplate directly below the flexible coupling as at *P*. To drive the pump it was connected to the coupling by a narrow flat belt. To insure that the pump will always be ready for service a second belt hangs over the bearing housing of the reciprocating pump ready for immediate use. If the belt in use breaks the other can be quickly put into place on the oil-pump pulley and engine coupling.

Santa Monica, Calif. J C ALBRIGHT

Hacksaw Blade Serves as Air Compressor Valve

RECENTLY A TWIN-CYLINDER feather-valve air compressor failed to deliver the required 80 psi pressure. After opening up the compressor we found one of the discharge valves, which is approximately 3 in. long, 0.5 in. wide and 0.025 in. thick, cracked in two pieces. Time lost in getting a replacement would have seriously affected our production. To get the compressor back into service quickly I ground the teeth off a hacksaw blade, rounded the ends to the required length and installed it in place of the cracked valve. Two months later we opened the compressor again and found the substitute valve in fine condition.

Springfield Garden, N. Y. E L O'BRIEN

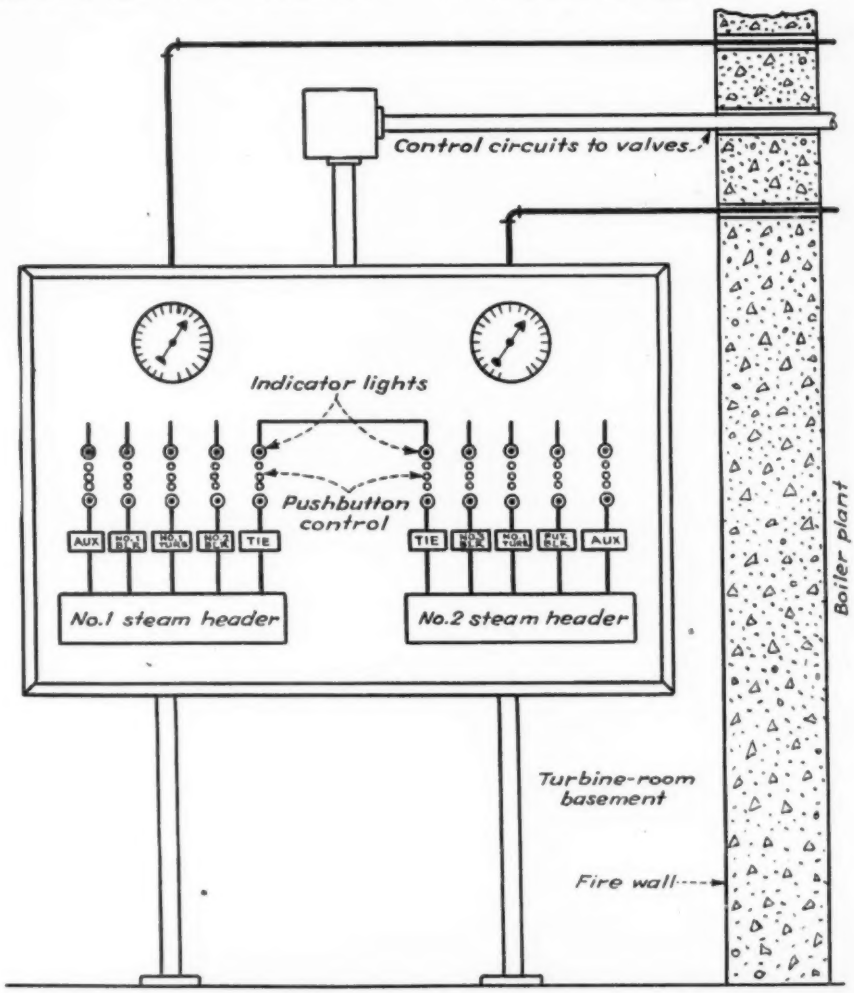
Adds Auxiliary Control to Motor-Operated Valves

WHEN MOTOR-OPERATED valves are used in steam headers and lines, dual control should be provided so that they can be closed from a safe place in event a steam line fails or in a similar emergency. Preferably, the auxiliary controls should be placed some distance away from the valves with a fire wall interposed, if possible.

In one large industrial power plant, controls were provided at the valves only. This condition had the operators worried because in the event of a steam-line failure it might not be possible to get to the valves to close them. To eliminate this hazard they built a panel board in the turbine basement near the boiler-room wall and mounted on it an auxiliary control station for each valve, as shown. A pressure gage is provided for each of the two steam headers.

Pushbuttons are used to actuate the valve-motor control switch. Indicating lights show position of each valve. A diagram of the piping system showing location of the valves, painted on the board, serves to guide the operator, to eliminate mistakes that commonly occur during an emergency.

The control board being isolated from the boiler room by the turbine room wall, it is now believed that any emergency to the boiler-room steam lines can be handled from the auxiliary control center. A break in a steam line in the turbine room can be handled from the controls at the valves.



READERS' PROBLEMS

Questions From Our Readers

Question 1

Wants Duties of Maintenance Men Defined

I would like to know how power engineers divide plant work between electrical and mechanical departments, as well as different individuals in these departments. I find that considerable confusion sometimes arises when lines are sharply defined between mechanical and electrical work.

For instance, on an electrically operated elevator does the electrician inspect and replace lifting cables? Who inspects and adjusts solenoid brakes on mechanical equipment? When an electrician dismantles a motor does he resurface the commutator or is this the machinist's job?

Upon what basis are the duties of a machinist based? Does he remain strictly within the machine shop, or does he work with regular repair mechanics out in the plant? What is considered a good balance between number of machinists and mechanics and what part do helpers play in making this decision? Is size of entire maintenance department governed to any extent by installed capacity, and does it naturally require more men as the plant gets older?

I realize that the examples I used are extreme cases but they are usually the ones that cause trouble.—AM

Question 2

Moisture Gums Up His Air Tools

We are constantly bothered by excessive moisture in our compressed-air lines. We use many small air-driven tools and this moisture does a first-class job of gumming them up.

Our air leaves the receivers at 100 psi and passes through an aftercooler before going to the shop. The aftercooler appears to be doing a good job of cooling the air and precipitating the moisture. As we have no trouble on the west side of the shop, I would like to know why it occurs on the east side. The 7-in. main to the east side passes through a 125-ft pipe tunnel and then comes up into the building. Temperature inside the tunnel is 145 F. Does this high temperature cause the air to absorb moisture which it precipitates when coming into the comparatively cool building? Do atmospheric conditions have any bearing on this?

Can Power readers explain this trouble or suggest a piping layout to eliminate it?—PMG

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs command additional pay.

Answers to August Question 1

The Question

Needs 180-Cycle Power Supply

WE WOULD LIKE TO HAVE *some information on building a unit to supply 180-cycle 3-phase 220-v service. Our plant is supplied with 60-cycle power service and we have on hand a 10-hp 3-phase 60-cycle 220-v 1800-rpm driving motor. We also have a 10-hp 3-phase 220-v 60-cycle 4-pole motor with a wound rotor grouped for eight poles.*

What changes must we make in this latter motor in order to get 180-cycle 220-v current from its sliprings if we drive it in a reverse direction with the first motor? Must we drive the wound-rotor machine overspeed to generate 180 cycles? Can POWER *readers advise us on complications we might be confronted with and what amount of power we can expect from this unit?*—KCJ

Use Larger Wire On Rotor

ACCORDING TO KCJ'S QUESTION, there appears to be sufficient apparatus available to arrange a 180-cycle frequency converter.

"Steinmetz Electrical Engineering Library." Vol 6, page 196 (1917 edition) says, "To transform from a frequency f_1, to a frequency f_2, the the frequency f_1 is impressed upon the primary of an induction machine, and the secondary driven at such a speed or frequency of rotation, f_s, that the frequency of slip is the desired frequency f_2." This applies to frequencies lower than f_1, the impressed frequency.

"If frequency f_2 is to be greater than the impressed frequency f_1, that is, the frequency converter increases the frequency, the rotation must be in a backward direction against the rotating field, so as to give a slip f_s, greater than the impressed frequency f_1 and the speed is $f_0 = f_s - f_1$."

From Steinmetz's formula, the rotor of the wound-rotor motor would have to be driven backwards at a speed of 3600 rpm, assuming it is reconnected into a 4-pole instead of the present 8-pole grouping.

If the stator could be reconnected into 8 poles, leaving the rotor as is and grouped for 8 poles, speed would be 1800 rpm.

The next question—What voltage will the rotor generate when operating as a frequency converter?—can be answered only by actually belting up the machine, connecting the 60-cycle supply to the stator and going into operation. If voltage is higher or lower than desired, a rewinding or connecting will effect the necessary change. If rewinding, use as large wire as possible, so that temperature is kept down and voltage drop is at a minimum to give good voltage regulation. Steinmetz says further "the three powers, primary electric, secondary electric and mechanical are proportional to their frequencies." From this it will be seen that the driving motor need not have as large a rating as the amount of 180-cycle power generated.

We have operated a 40-kw frequency converter using a 30-hp motor and converting 25 to 60 cycles for the past six years with good success sometimes drawing as much as 50 kw.

Toronto, Ont. J C NUTTER

Consider The Driving Motor's Slip

IF KCJ'S WOUND ROTOR MOTOR will operate correctly as an 8-pole 220-v 900-rpm unit, it can be driven in re-

verse direction coupled to the 10-hp 1800-rpm motor and will produce 180 cycle energy from its slip rings. The frequency will be slightly less than 180 cycles because of the motor slip, but probably close enough to get the advantage of direct drive.

The problem as stated does not refer to rotor voltage; it is necessary to set up the equipment and measure the voltage. It may be possible to obtain the necessary value by regrouping the rotor coils. However, in normal cases rotor voltage is low and it might be necessary to use either auto or regular transformers to obtain the necessary 220 v.

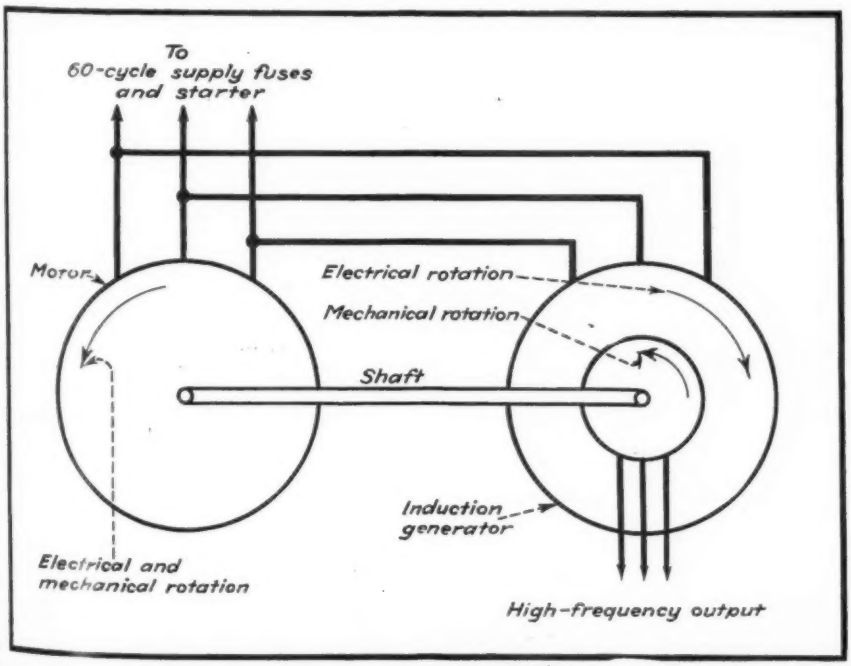
The amount of power to be obtained at 180 cycles will be higher than the capacity of the wound-rotor motor. The driving motor furnishes more than one half the 180-cycle energy, plus part of the generator losses. The stator of the induction generator furnishes the balance of the 180-cycle energy.

The limiting factor is heating in the rotor and as its voltage will be approximately twice normal at 120-cycle operation and three times normal at 180 cycles the output will be, with the same copper heating, two times normal at 120 cycles, or three times at 180 cycles.

In a similar case on our property this scheme is being used to furnish power to 60-cycle ac welders from 30-cycle service. I would suggest that the stators of both motor and induction generator be connected in parallel through the same fuses and switch, so that in case the motor stops no potential will be left on the wound-rotor motor. If voltage is left on this stator, the rotor frequency will be the same as impressed on the stator because of transformer action. Then, as the motor reverses with load on the rings, the frequency will go down. This effect might destroy the high-frequency equipment connected to the 180-cycle source of supply.

In the equipment we have installed, the tested efficiency from the low frequency to the high is 51% at 50% load. This includes all losses in motor and generator. On our installation this is the total load available and no further tests could be made. Our equipment has been in service 16 months and has given excellent service and the high frequency side has very good voltage regulation.

Canon City, Colo. L F JAYNES



Will Unit Withstand Twice Normal Speed?

KCJ's QUESTION does not give all the information required for a complete reply, particularly about the motor to be used as an induction generator when driven in the reverse direction to its normal torque from the 60-cycle supply circuit. Could this unit be operated at 100% above its normal speed? There is also no information about the energy to be supplied and the duration of the loading period.

The writer had occasion to conduct tests on a number of 133-cycle transformers, which was one of the earlier frequencies. This was done by driving the rotor of a 60-cycle fed stator by means of a dc motor and holding the speed by shunt-field control; this was, of course, only slightly above normal speed in the reverse direction. Actual voltage for the equipment under test was obtained by stepping up the rotor voltage through an autotransformer.

Assuming the induction generator can withstand double speed for the period required, simplest and most direct way to obtain 180 cycles would be to employ pulleys to give the correct speed ratio and use either regular or autotransformers to obtain the required 180-cycle voltage.

A more elaborate method (one employed by the writer) would be to drive a 60-cycle alternator of sufficient capacity by an adjustable speed dc motor and the induction generator by another adjustable speed dc motor including, of course, the step-up equipment for the higher frequency voltage. This arrangement has the advantage of making possible a slightly higher stator frequency by driving the alternator above its normal speed which in turn results in a lower reverse-direction speed of the induction generator.

Neither of the foregoing require any internal changes or change in the number of poles although the motor manufacturer can state at once whether such a change is feasible. Second method obviously permits accurate control of all factors concerned.

It is readily possible without elaborate equipment to obtain higher frequencies by series connections. For instance, 180 cycles can be obtained by using one driving motor and two driven units, feeding 60 cycles to the stator of the first driven unit, which results in a 120-cycle frequency at its slip-rings; then feeding the stator of the second unit with the 120-cycle output, resulting finally in 180 cycles at the sliprings of the second driven unit. It is necessary to provide suitable transforming equipment between the induction machines, as well as at the terminals of final sliprings to adjust voltage to required value. This method has the advantage of obtaining 180 cycles with both of the driven units operating at normal speed in a reverse direction. It is understood that design of the second unit would have to be suitable for 180 cycles at least in the stator, for continuous use.

Brooklyn, N. Y.
C O VON DANNENBERG

Dangerous Tool Speed

IF KCJ EXPECTS to use tools with standard 3600-rpm 60-cycle motors on 180-cycle current, he should determine

whether the rotors will stand the increased speed of 10,800 rpm.

To supply 180-cycle 220-v power let's consider the problem in terms of 60-cycle current, which is easier for most of us to understand.

Stator of the slipring motor should be rewound and changed to 8 poles and be suitable for 60-cycle 220-v current. The wound rotor should be rewound or regrouped so that the standstill ring voltage is 73.38 v when the stator is excited with a 60-cycle 220-v 3-phase power supply.

After the slipring motor has been changed, as suggested, and driven in the direction reverse to what it would run as a motor, at 1800 rpm, there is available at the rings a potential of 220 v and a frequency of 180 cycles.

The original tool motors which are to run on 180-cycle 220-v current, must be rewound so they will be suitable for 73.38 v at 60 cycles. They will then be normal at 180 cycles and 220 v.

One-third of the power from the frequency changer will be supplied by transformer action between the stator and rotor and the other two-thirds by generator action of the rotor being rotated in the field set up by the frequency changer stator. This latter portion is supplied by the driving motor.

Considering the power that may be expected from the set, sufficient data were not given on the slipring motor but, if the 10-hp driving motor is used, approximately 12.75 hp can safely be drawn from the unit.

Memphis, Tenn. C DEMERE

Rewind Machine For Correct Voltage

KCJ'S WOUND ROTOR MOTOR can be used to deliver 180 cycle per second current, but the voltage delivered will depend on the voltage ratio on open circuit. This ratio should be three to one as the voltage at triple frequency will be three times normal open-circuit voltage.

To obtain 180 cycle at 1800 rpm from a 60-cycle circuit, an 8-pole winding is required. If the present 8-pole rotor has an open-circuit voltage of approximately 220 v, the delivered voltage would be 660 v. If transformers are available this could be stepped down to 220 v, but the generated voltage may be too high for the present motor insulation.

Only alternative would be rewinding the machine for the required voltage ratio of three to one.

Amount of power required by driving motor in this case is approximately ⅔ of output of the frequency changer. The remaining one-third is supplied by transformer action in the machine.

Hamilton, Ont. J A COULDEN

Construct A Revolving-Field Generator

AS THE SPEED at which KCJ's 220-v 3-phase 60-cycle 4-pole motor now runs is 1800 rpm, there would have to be a proportionate increase in speed to generate power at 180 cycles. Relation between speed, poles and frequency may be written as the equation: $F = \frac{P \times S}{2 \times 60}$. Where F = the frequency in cycles, P = number of poles, and S = revolutions per minute. For a given frequency, as the number of poles is increased the mechanical speed decreases proportionately. By using the 4-pole grouping the reverse speed of his motor will be 3600 rpm—a speed likely to prove far too high for the unit. Using an 8-pole grouping reduces the operating speed to 1800 rpm.

The change will be far more successful if the motor is reconstructed into a revolving field generator with 12 poles so that the speed will be 1800 rpm. By doing this he will have to transmit the field current only. It is also less costly to reconstruct a revolving field than a revolving armature. In order to maintain the speed constant and also to get better voltage regulation in making a frequency change the voltage on the motor should be varied in the same proportion as the frequency is changed. The amount of power that this unit delivers depends primarily on how the reconstruction work is performed. Efficiency of the unit should at least be equal to that as a motor.

New York, N. Y. PAT DONOHUE

Answers to August Question 2

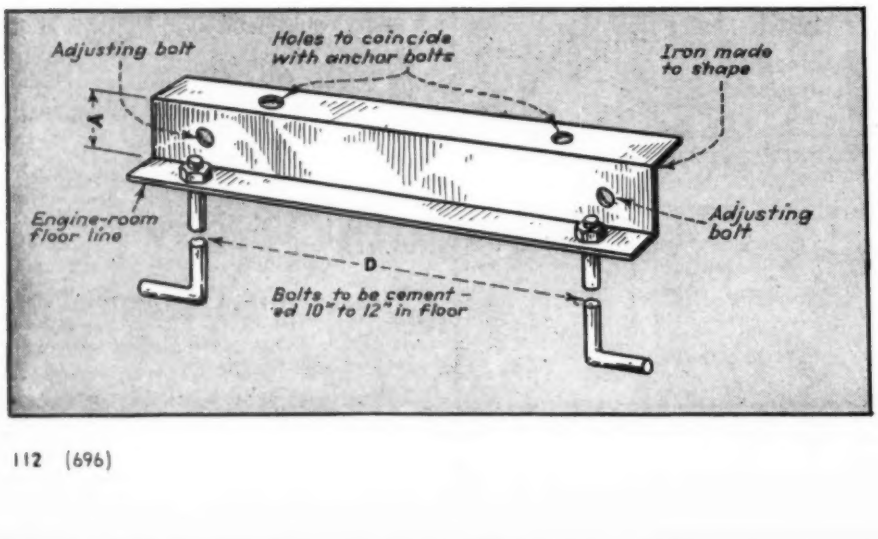
The Question

Engine Foundation Trouble

ONE OF OUR OLD RECIPROCATING *steam engines oscillates back and forth on its brick foundation approximately ⅛ in. As the unit is quite old considerable oil seepage has entered the foundation. Individual bricks still appear tight, as no movement can be detected. Tightening the foundation bolts has not corrected the trouble. Grouting still remains hard and strong except for the small clearance between the edge of frame and grout. We assume this clearance was caused by engine movement.*

Can we correct this trouble by regrouting on top of the old brick or should the entire foundation be rebuilt? Could we use angle guy bolts anchored in the concrete floor and connected to lugs welded to the engine frame to eliminate this end motion?

Extended outage of this machine, while possible, will require purchase of outside power so we would like to know how we can make either temporary or permanent repairs in the shortest possible time.—MC



Suggests Z-Shaped Brace

ONE WAY to stop movement of MC's engine is to take pieces of angle iron and weld them to fit the foundation. At the base of the engine there is usually a ridge 4 to 6 in. high, and the iron brace must conform to this section.

The height *A* will be equal to that of the baseplate ridge. Cut holes to fit

the bolts now in the base. Two nuts, one a holding-down nut and the other a locknut can be used, or a nut and lock washer will suffice if the correct size washer is at hand.

The angle iron in the sketch can be installed at both head and crank ends of the engine base. Bolt can have a straight piece of metal welded to the head to give it a T-shape or, better still, heat and bend it to the shape of an L.

After the bolts are inserted in the floor close to the engine base, put the angle iron in place and tighten down with its nuts. After this is done the bolts in the vertical side of the angle can be tightened both at head and crank end of engine base. After the engine is fastened properly, check over alignment of entire unit and generator.

Philadelphia, Pa. T F CUNNINGHAM

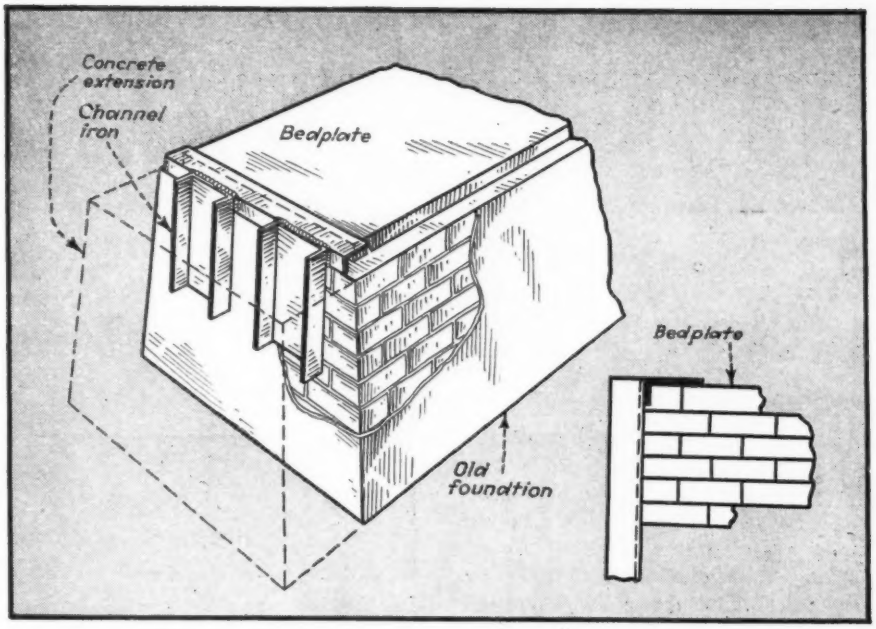
Eliminate Strain On Steam And Exhaust Piping

TO AVOID an extended shutdown of his engine at this time, MC can, as suggested in the problem, use angle-guy bolts if they are securely anchored to the floor. For a more permanent job, use a turn-buckle in each guy bolt so that the lateral movement may be more equally divided, and any lost motion taken up by tightening the turnbuckles. While this is only a temporary repair it eliminates the strain on the steam and exhaust piping and thus prevents an accident that is liable to occur if the condition continues.

New York, N. Y. PAT DONOHUE

Suggests Channel-Iron Anchor Stubs

WHEN BOLTS in an old brick foundation become loose, short of practically rebuilding the brickwork, attempts to restore their holding power are not often successful. The statement that tightening the foundation bolts does not prevent engine movement on the foundation indicates that the foundation may have disintegrated to a greater extent than an external examination shows; therefore little dependence can be placed on the bolts. Provide some means for stopping end motion of the engine other than depending entirely on the present foundation. This can be done by bracing both ends of the bedplate and adding reinforced concrete extensions to the ends of the present brick foundation, as in the sketch.



Exact manner of placing the steel members at the ends of the bedplate is, of course, determined by its form, but any open spaces between this plate and the steel bracing should be tightly wedged. Steel channels and angles could probably be salvaged from scrap. Such an arrangement stabilizes the entire foundation and is less costly than removal and rebuilding of any considerable amount of brickwork to make the foundation bolts secure.

Although MC's question does not mention engine size or type, it might be well to investigate flywheel balance. The writer recalls an instance wherein a badly unbalanced flywheel caused a noticeable end movement of a medium-speed engine, until the fault was detected and remedied without repairs to the foundation. However, loose foundation bolts are more likely causing MC's trouble.

Jersey City, N. J. I S CHAMBERLAIN

Angle-Guy Bolts Are Not Permanent Cure

ACCORDING TO MC's description, it is evident that his engine foundation trouble is a matter of dampening. To absorb these alternating surges, the volume of concrete should be in proper proportion to weight of engine. Of course concrete volume varies with soil condition and type of engine; with or without outboard bearing. I suggest that MC contact a competent concrete firm, whose expert advice should assist him in getting out of his difficulty.

In my opinion, he could proceed adding a proper and perhaps larger footing, interlocking it thoroughly with the present brick foundation. He could do this without interruption of production or engine shutdown.

I advise against angle-guy bolts welded to the engine frame. Such a method would not eliminate the foundation's reciprocative motion.

Schenectady, N. Y. CARL BACHMANN

Examine Bedplate Leveling Wedges

PERHAPS MC'S ENGINE is still resting on the wedges that were used for leveling the bedplate. If this is so, any slight shrinkage of the foundation would separate it from the bedplate leaving the wedges as sole support of engine.

Large surface contact between engine and foundation is necessary to absorb or oppose the shaking forces inherent in a reciprocating machine. And, even though the wedges are sturdy enough to support the weight, they just don't have sufficient surface area to make a good solid tie between foundation and engine even when no oil is present.

Oil seeping into the grout is bound to creep over and between the wedges and reduce friction at this point. This, in turn, causes greater freedom of movement.

I would like to suggest that MC remove the grout at anchor bolts to see whether wedges were left in place. If so, he will have to remove all oil-soaked grout and replace it with a good, sound mixture. Before grouting, check the bedplate for level condition. After the grout is set, remove the wedges and tighten down the founda-

(Continued on page 184)

Q&A QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

7—*Steam Gages and Water Columns*

Seventh in a series that is running in every number of POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment—its construction, principle, maintenance, efficiency and safe operation. In outstanding fashion he drills the young power engineer, polishes up the oldtimer's knowledge, helps all comers pass engineer examinations and win certificates of higher grade. Besides being invaluable as a study course for examinations, it is a good review for the chief himself who wants to do a better job.—Editor*

Q 1—What are boiler fittings?

A—They are valves, gages and other connections or devices, attached directly to the boiler and necessary for safe and efficient operation.

Q 2—Name the most important fittings on a steam boiler and explain their uses briefly.

A—Their names and uses are: *Safety valves* prevent dangerously high pressure and possible explosion by relieving boiler of excess steam. *Steam gages* indicate pressure of steam in boiler. *Water gages* show water level in drum. *Gage or try cocks* test water level. *Fusible plugs* prevent damage to boiler by giving warning of low water. *Stop valves* control steam flow from boiler, cutting it on or off line as required. *Feed connection* includes check valve, stop valve and piping needed to convey and control feedwater to boiler. *Blowoff connection* includes blowoff valves and pipe to reduce concentration of soluble impurities in boiler water, to blow out mud or sediment, and to drain boiler when necessary.

Q 3—What types of gages indicate steam pressure?

A—Two main types of pressure gages are *Bourdon* and *diaphragm*. Fig. 1 (A) is a single-tube Bourdon gage with dial removed to show interior mechanism.

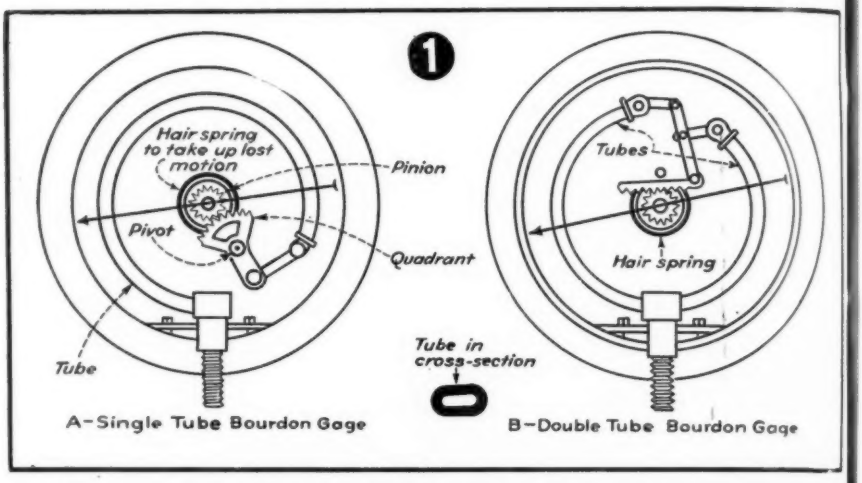


Fig. 1—Two Bourdon gages that are used to indicate steam pressure

The bent Bourdon tube, of oval cross-section, is closed at one end and connected at the other to boiler pressure. Closed end of tube is attached by links and pins to a toothed quadrant which in turn meshes with a small pinion on the central spindle. When pressure is applied to interior of oval tube, it tends to assume a circular cross-section, but before the tube can do so it must straighten out. This tendency to straighten moves the free end, turning the spindle by the links and gearing, and causing the needle to move and register the pressure on a graduated dial.

The double-tube Bourdon gage Fig. 1 (B) is more rigid than the single-tube. It is more suitable for locomotive and portable boilers.

In the diaphragm gage a corrugated, flexible metal diaphragm is clamped tightly between two flanges and connected to a toothed quadrant which meshes with a small pinion on the central pointer spindle.

Recording gages have a mechanism similar to that of tube and diaphragm gages described, but a revolving chart operated by clockwork takes the place of the stationary dial, and a pen which traces a record on the chart is attached to end of pointer.

Q 4—What is the purpose of the steam gage and how should it be connected to the boiler?

A—The steam gage shows steam pressure in pounds per square inch. Connect it directly to the boiler at the highest point of the steam space or to the water column or water-column steam connection. The steam gage should be graduated to at least 1½ times set pressure of safety valve. It should be well lighted and in plain view of the operator. A siphon or equivalent device must be placed between gage and boiler, and a tee or lever handle cock provided near the gage to shut it off from the boiler when necessary. Tee or lever handle of this shutoff cock must be parallel to the pipe connections to the siphon when cock is open.

If the steam gage is directly connected to the boiler no other valve may be placed on the line from boiler to gage unless length of pipe exceeds 10 ft, in which case a shutoff cock, or valve, arranged so it can be sealed open, may be placed near the boiler.

Q 5—What is a siphon?

A—This device prevents steam entering the steam gage. Three forms in Fig. 2

(*Continued on page* 116)

Air filters on jeeps are put there for just one reason . . . to keep 'em clean to keep 'em working. And keeping things working is the order of the day just *everywhere* today. In a busy arms factory it is more necessary than ever to keep vital motor control working. You can accomplish this by *working* on motor control to keep contacts clean. Or you can insist on Cutler-Hammer Motor Control with the VERTICAL *dust-safe* contacts that *shed* dirt and *keep themselves clean.* With unfailing motor control performance so important and manpower for maintenance so scarce, you too will be glad you insisted on Cutler-Hammer VERTICAL Contact Motor Control. CUTLER-HAMMER, Inc., 1358 St. Paul Avenue, Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

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Q&A FOR POWER ENGINEERS

(Continued from page 114)

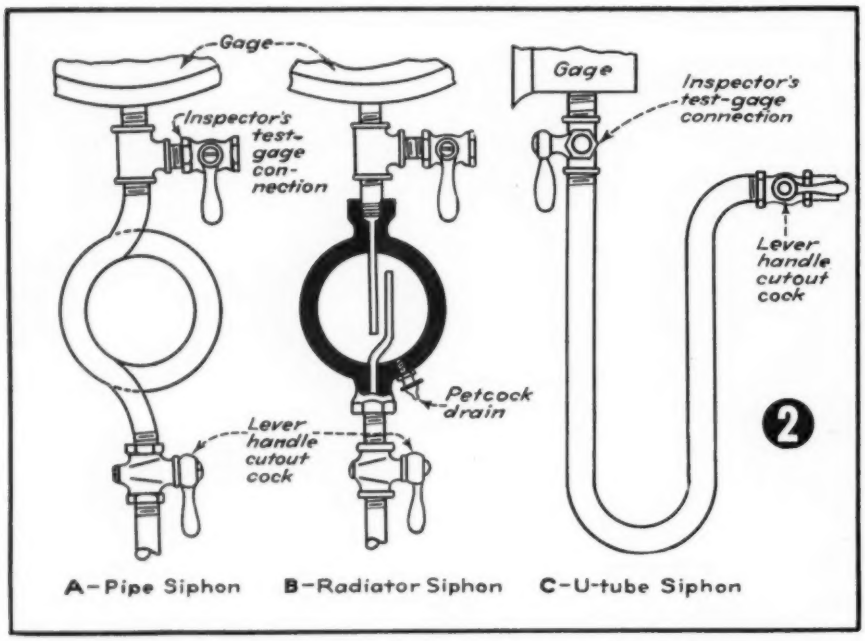


Fig. 2—Three forms of siphon prevent steam entering the steam gage

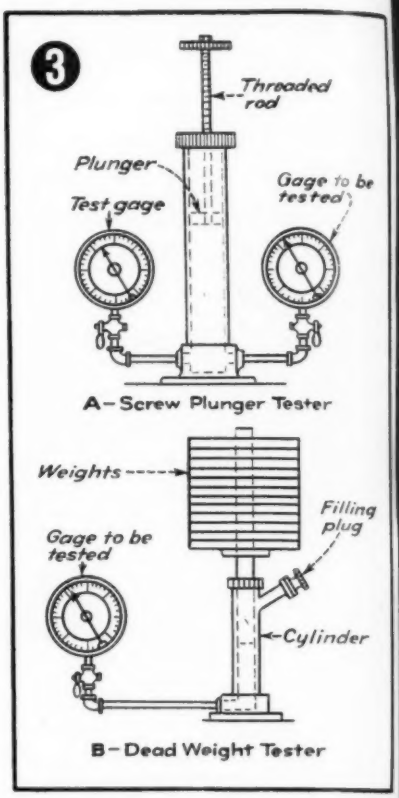


Fig. 3—Two types of gage testers

Pipe siphon (A) is simply a piece of pipe, bent as shown. *Ball* or *radiator* siphon (B) is a hollow cast ball containing two small tubes attached to the inlet and outlet. Third form (C) is a U-tube. In all three, water collects because of steam condensation, and the water transmits pressure to the gage, at the same time preventing fresh steam entering the gage. As a siphon cannot drain itself, remove or drain it when the boiler is being shut down for a lengthy period and there is danger of freezing.

ASME Code requires that each boiler have a ¼-in. pipe-size connection to attach a test gage, to check the boiler steam gage while boiler is in service. Connections for this purpose are shown in Fig. 2, between siphon and boiler steam gage.

Q 6—How are steam gages tested?

A—They are tested in three ways: (1) By comparison on the boiler with inspector's test gage. (2) By a screw plunger pump. (3) By a dead-weight plunger pump.

In first method, test gage is attached to the boiler connection for this purpose and the two gages are compared as boiler pressure rises or falls.

In second method, Fig. 3 (A), test gage and gage to be tested are attached to a tee-shaped connection at bottom of a cylinder, fitted with a plunger attached to a threaded rod passing through the cylinder cover. To operate, unscrew top cover, fill cylinder with water or light oil, screw on top cover, and force plunger downward by turning handle on end of threaded rod. This puts equal pressure on both gages.

In the dead-weight tester, Fig. 3 (B), plunger, working in a cylinder, "floats" on oil and is loaded by weights.

Q 7—Why is a siphon used between boiler and steam-pressure gage?

A—The siphon prevents steam entering the gage. If steam were allowed to pass into the gage tube of a Bourdon gage, high temperature would expand the tube and cause a false reading. High temperature might also have a bad effect on metal.

Q 8—What is meant by gage pressure and absolute pressure?

A—Gage pressure is pressure *above* atmospheric pressure. Absolute pressure is gage pressure plus atmospheric pressure. Atmospheric pressure is 14.7 psi at sea level; it decreases as height above sea level increases. Gages on steam boilers indicate gage pressure.

Q 9—What is the purpose of a water gage and how is it attached to a steam boiler?

A—The water gage shows water level. In boilers like the locomotive or vertical tubular types it is usual to attach water-gage glass fittings directly on the boiler head or shell, but in HRT and dry-back marine boilers the setting or smoke box prevents direct attachment, so a water column is used. Water columns are also used on water-tube boilers where direct attachment to drums is not convenient.

Q 10—What is a water column and how should it be connected to a boiler? Sketch a water column and its connections.

A—A water column is a hollow casting, connected by pipes at top and bottom to the boiler's steam and water spaces. Fig. 4. The steam-pipe connection to top of water column must not be lower than top of glass, and the water-pipe connection to the column must not be higher than bottom of glass. Minimum size of these connecting pipes must not be less than 1 in. Use plugged tees or crosses wherever practicable at right-angle turns so that all parts of piping may be easily examined and cleaned by removal of plugs.

Valves are not absolutely essential on steam and water connections to the water column, but if used, they must be outside screw-and-yoke or lever lifting gate valves or stopcocks with lever handles or other valve types that offer a straightway passage and show by position of operating mechanism whether they are open or closed. Lock these valves or cocks open or sealed open.

The water gage glass with its steam,

(Continued on page 118)

"Vitamin Y" Puts New Pep in Steam Equipment

PERHAPS you've never heard of Vitamin Y. For the sake of this message, it stands for Yarway Impulse Steam Traps. But you have heard of Gelatin Products Company of Detroit—world's largest producer of soft, elastic gelatin capsules, and big factor in the production of the health and energy-giving vitamins which hold the center of the stage in public interest today.

And here is the connection. A Yarway representative in this company's territory writes: "A year or so ago they started using Yarway Traps after they had been called to the attention of the Fine Chemical Div. Soon they were using them exclusively in this division and throughout the rest of the factory.

"They like them for their ability to work on any varying pressure, their freedom from air-binding and their compactness. Much of their equipment is small and the piping complicated. Yarways go in especially well.

"In all, they have over a 100 Yarways at work on heaters, stills, reaction kettles, unit heaters, etc.

"It would seem to me that we might play up the copy on the vitamin angle—vitamins to increase energy in the human body—Yarways always to increase the energy received from steam, etc., etc. With some thought we could make a catchy ad from this copy."

We think so too, but he could have mentioned that Yarway Impulse Traps usually cost no more to buy, than to repair an ordinary trap. Also that more than 250,000 have been purchased and over 100 convenient Mill Supply Distributors carry them. Why don't you see your supply house or write for Bulletin T-1737.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

Q&A FOR POWER ENGINEERS

(Continued from page 116)

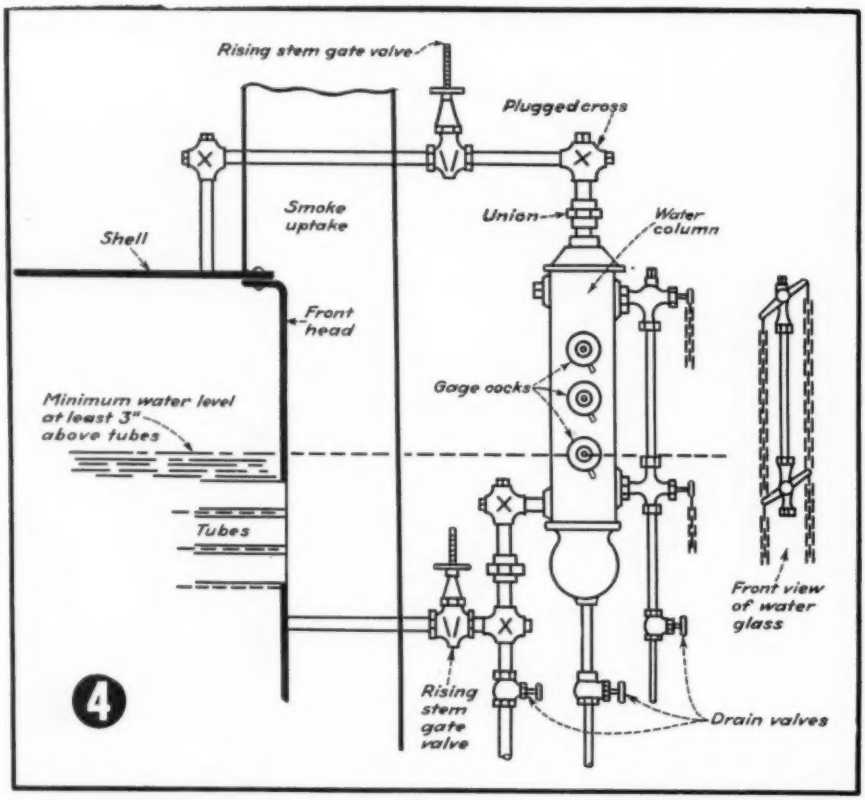


Fig. 4—One way to connect a water column on an HRT boiler

water and drain valves is placed on the water column as shown, and also the required number of gage cocks. Damper regulators, feedwater regulators, steam gages and other apparatus that do not require or permit escape of an appreciable amount of steam or water may be connected to the pipes leading from water column to boiler. Cast-iron water columns may be used for pressures not exceeding 250 psi, and malleable iron columns for pressures not exceeding 350 psi. Above that, use steel columns.

Q 11—How do you test the water column and water gage glass to prove that all passages are clear, while boiler is in operation?

A—1. Close top valve on column and top valve on glass. Open drain valve on glass. If water blows freely from drain, the water passages from boiler to column and from column to glass are clear.

2. Close bottom valves on column and glass, and open their top valves. If steam blows freely from drain valve at bottom of glass, steam passages from boiler to column and from column to glass are clear.

3. Close drain valve on glass and open drain valve on column. If steam blows freely from column drain, column itself is clear.

4. Close column drain valve and open bottom valves to column and glass. Note whether water rises quickly to correct level. If action is sluggish, some obstruction may still be in pipes or valves. Make sure all drain valves are tightly closed and all other valves wide open. Seal valves on water-column pipe connections in open position.

Q 12—What points must be observed in fitting up a water gage?

A—Gage must be well lighted and so placed that water level can be easily seen at all times. Do not use water glasses or water glass guards that obscure water level. Automatic ball-check shutoff valves may be used if they comply with ASME Code. Quick-closing valves with lever handles and hanging chains shut off steam and water connections without danger of operator being scalded if a glass breaks. It is important to set visible bottom of gage glass at correct distance above highest point of boiler heating surface that might be damaged by low water.

On very high boilers the water-gage glass is sometimes set with top tilted outward so that it may be more easily seen, and special forms of gages are sometimes used with lamps and mirrors to project gage reading to floor level. Flat glasses are used in gages for very high steam pressures and may be constructed to make water appear black and steam white.

In one particular make of high-pressure water gage, water space appears green in color and steam space red. These color changes make it possible to read the gage more easily.

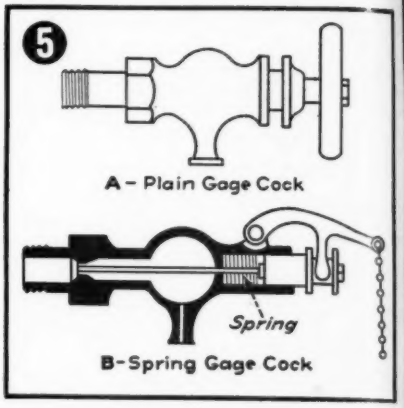


Fig. 5—Two types of gage cocks

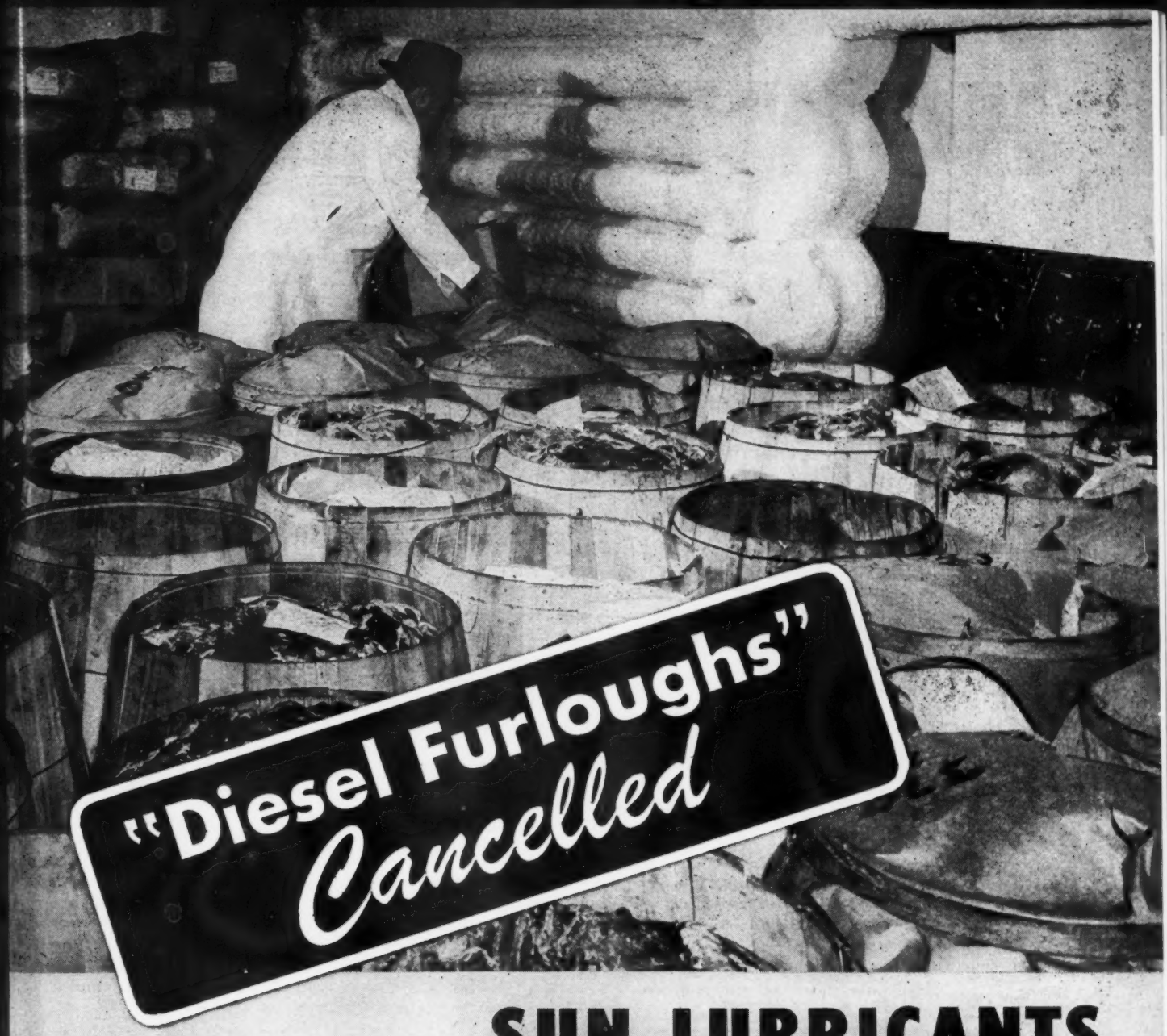
Q 13—What are gage cocks and where are they used?

A—Gage cocks are small globe valves with side outlets and wheel or lever handles. They are a check on the water gage or a temporary means of finding water level when a gage glass breaks by observing whether water or steam blows out when a cock is opened. When the gage glass is placed directly on the boiler head or shell, gage cocks are also directly attached. When a water column is used, gage cocks are placed on side of column, as in Fig. 4.

According to ASME Code, each boiler must have three or more gage cocks located within the visible length of the water glass, except when a boiler has two water glasses independently connected to the boiler, at least 2 ft apart. Locomotive boilers not over 36 in. in diameter or other firebox or waterleg boilers with not more than 50 sq ft heating surface need have only two gage cocks. Bottom gage cock is placed level with visible bottom of water glass; others are spaced vertically at suitable distances.

Q 14—Sketch two types of gage cock.

A—Fig. 5 (A) is a simple gage cock with a wheel handle for opening and closing, while (B) is a spring-lever-handle type in which the valve is kept closed by a strong spring and opened by a chain-operated lever.



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ter the switch to SOLNUS, shutdowns for inspections were reduced 75%. Hard carbon troubles vanished. SOLNUS OILS keep the plant running day and night without breakdowns due to faulty lubrication. These wholly distilled, durable lubricants are low in carbon content—neutral in acidity.

What have you done to put your plant on a more efficient war-time operating basis? Talk it over with a SUN "Doctor of Industry" and let him prove to you the value of applying the right petroleum product at the right place. Write

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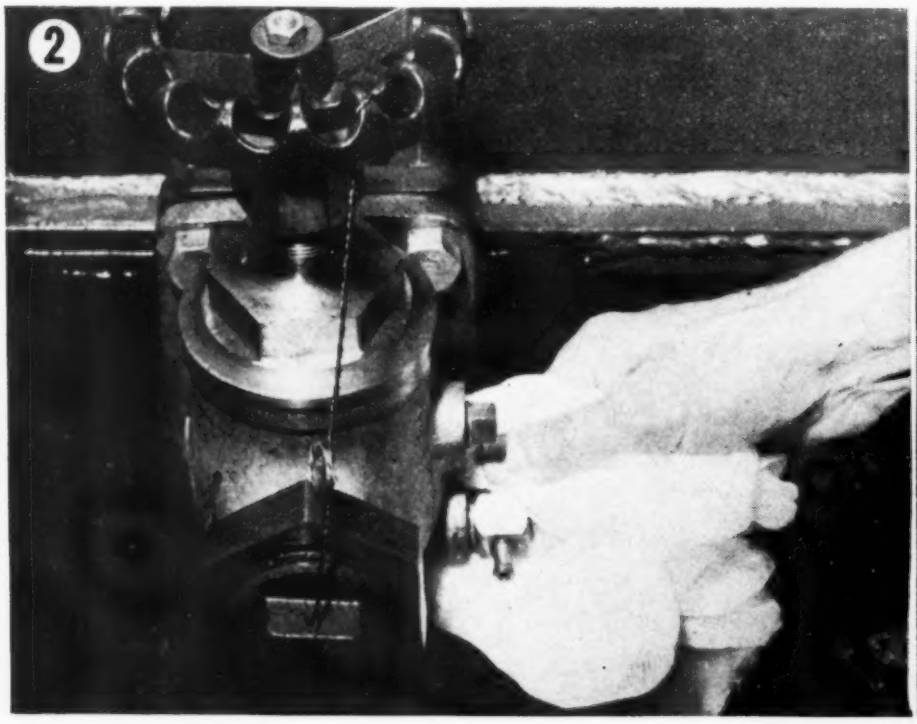
HOW TO TAKE SAMPLES OF TRANSFORMER OIL

WHEN TESTING dielectric strength of transformer insulating oil, results of the tests may be misleading if the oil samples are not taken properly from the transformer and protected against contamination from outside sources until they are tested. Take samples from top and bottom of all transformer oil containers. Some specially designed transformers have as many as five separate compartments containing oil. Take samples from each compartment. Rinse sample containers with oil-free gasoline and thoroughly dry before using, preferably in an oven at a temperature of about 215 F. After drying, keep containers stoppered until used. It is preferable not to take samples except when the oil is at least as warm as the surrounding air. Insulating oil is not hygroscopic, but cold oil may condense enough moisture from a humid atmosphere to affect seriously its insulating properties. Take samples from outdoor transformers on a clear, dry day only and guard against contamination by wind-blown dust and dirt. (*Photos, courtesy General Electric Co*)

1 If possible use one-quart large-mouthed 16- or 32-oz clear-glass bottles to hold the samples, because presence of free water can be readily observed. If containers are metal, make sure they are free from rust or solder. Do not use rubber or compositions of rubber for gaskets or stoppers. The glass container in the photo has a plastic cap. Inside it, a clean piece of aluminum or tin foil prevents the cork disk in the cap top from coming in contact with the oil.

2 Before drawing off a sample from the bottom of the tank into the container, carefully clean the valve. Allow enough oil to run out of the sampling valve (on large transformers about one quart) to remove any moisture that may have collected in the valve and its connection. Before taking the sample, rinse container with some oil from the transformer and let container drain as an added precaution against moisture getting into the oil sample.

3 After drawing the sample carefully, close the container to prevent leakage and exposure of oil to atmosphere. When samples are taken from more than one place in a transformer or from more than one transformer, carefully identify each sample on the container. If samples are sent away for testing, pack bottles carefully to avoid breakage in shipment. When in doubt about tightness of stoppers seal them with paraffin or wax after drawing the samples.



the Shell Game

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REFRIGERATION NOTEBOOK — 7

Know-How of Choosing Summer Air Conditioners

By TERRY MITCHELL, ME, *Frick Company*

NOT SO MANY YEARS ago the millpond's frozen surface and nearby icehouse furnished man's only relief from summer heat. Then came refrigerating machines to meet the demand for ice in greater quantity and of better quality. Soon, refrigeration led to the air cooler and conditioner. First a luxury product, air conditioning is now essential in many manufacturing processes. It does a 5-point job involving temperature regulation, humidity, cleanliness, ventilation and air circulation best suited to individual needs. Of the numerous arrangements, a study of five typical ones simplifies selection.

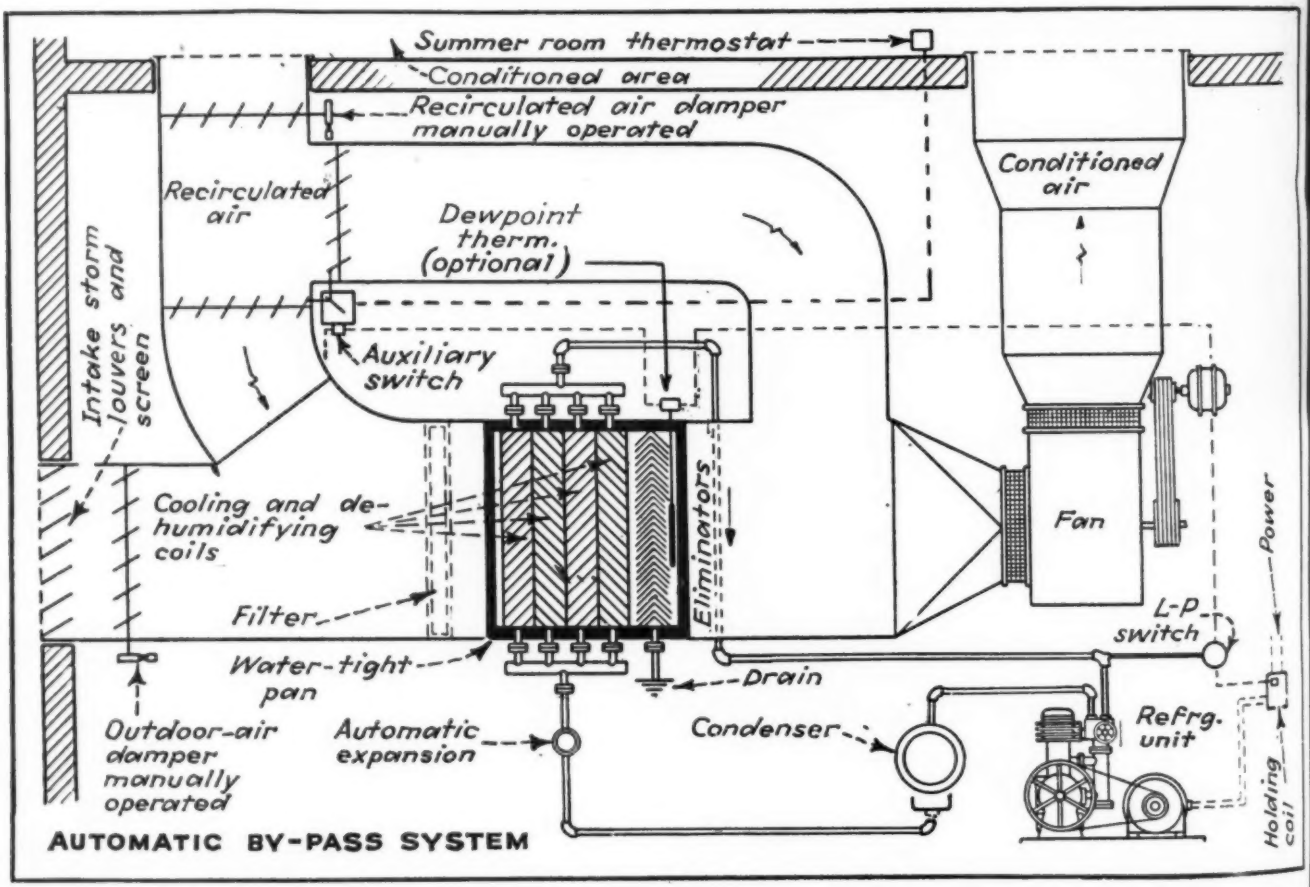
Unit air conditioner: Often used in cafeterias, offices, shops and first-aid rooms, this is the simplest system. As usually applied it cools the air an average of 15-20 F, thus squeezing out excessive moisture. Both fresh and recirculated air pass through a filter that removes dust, pollen, soot and bacteria. The cleaned air then goes over finned cooling tubes where excess moisture condenses out as temperature drops an average of 15 F. Finally, the air enters a blower which discharges it through grills into the room. By reducing amount of air handled, coils are kept colder and air drier than when a large quantity is circulated. Fan speed should be adjustable because operation is continuous. Use cold water at 45-55 F if refrigeration is not available. Operated by thermostat only, unit does not directly control humidity.

Only a few hours are needed for installation — connecting power, water and drain lines and fitting in place any necessary ducts. All heat is carried away from machinery space by a water-cooled condenser and motor.

Multiple unit: When load is not more than 30 hp, two or even three unit coolers can be connected to the same machine for better humidity control. One unit handles only fresh air, the other only recirculated air.

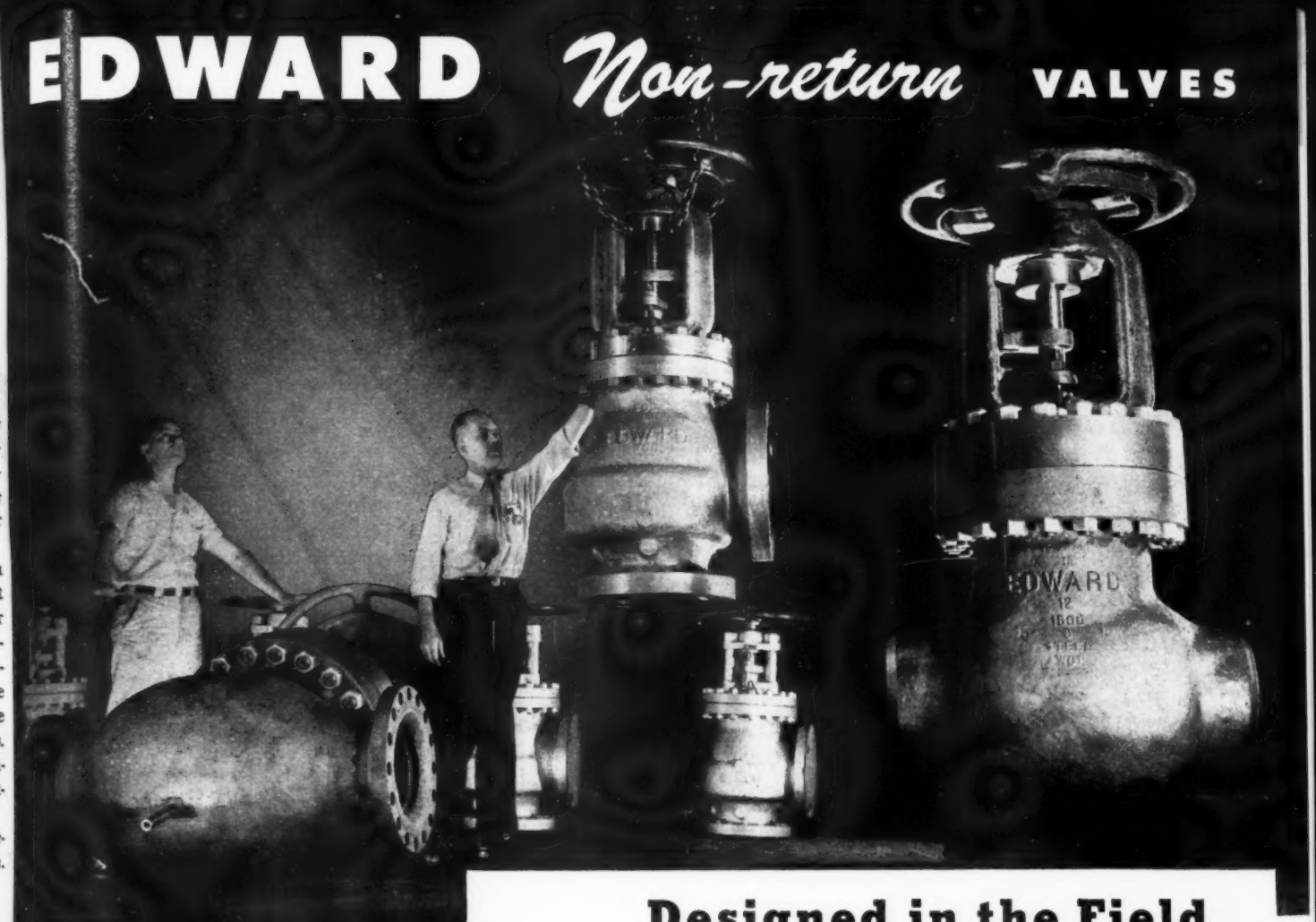
While both fans run continuously, a 2-stage thermostat turns refrigerant through a magnetic valve into fresh-air unit before it is admitted to recirculated-air unit or units. Compressor operates only when suction-line pressure rises; it works under a higher, more effective pressure as load increases. This patented arrangement keeps relative humidity from rising when outdoor weather is mild.

Note: Other air-conditioning arrangements will be described next month.



This patented system is recommended when vapors are given off from process work or large groups of people. The amount of air passing the cooling coils can be varied up to 60%. Further details of the system will be given next month.

EDWARD *Non-return* VALVES



Designed in the Field

EDWARD NON-RETURN VALVES are almost entirely a product of what station operators and designers told us they wanted.

For instance, they insisted on minimum resistance to flow....

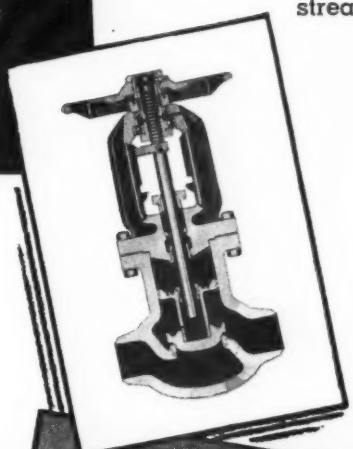
Hence, the Edward body design with cored-out, streamlined and integrally cast body ribs for three-point disk guidance with the least possible interference to flow . . . the hour glass disk-piston design . . . the smooth internal contours.

Also, they wanted easy closure...

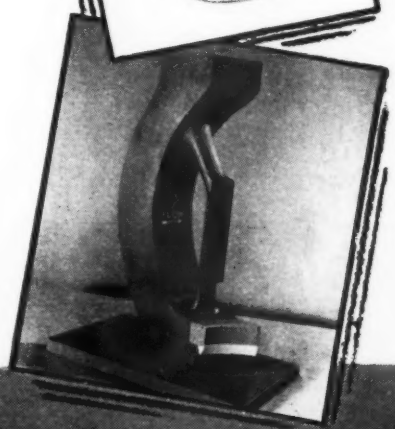
Hence the Edward patented Impactor handwheel, most effective means known for easily closing a valve against high pressure.

And these are but a few of the many field-inspired points of Edward non-return superiority. For non-return service from 150 to 1500 lb sp it pays to get the Edward story first.

Design of the famous Edward Impactor handwheel. Lugs of wheel strike cross arm attached to stem, speeding opening or closing.



Cut away of Edward non-return valve shows smooth, streamlined contours that reduce turbulence and offer minimum resistance to flow.



Three integrally cast body ribs like this guide disk accurately, yet let flow through with least interference.

THE EDWARD VALVE & MANUFACTURING CO., INC.
1220 W. 144th STREET • EAST CHICAGO, IND.

EDWARD *Steel* **VALVES**

ARGUMENT CORNER

I Polished That Knob So Carefully

WHEN I WENT TO WORK at the power house I was seventeen. After watching the flywheels turn for my first twelve-hour shift, I went home with the firm conviction that I would be an engineer within a week.

There were three 300-kw 600-v dc generators driven by tandem compound corliss engines. How they intrigued me! I wiped them and polished the bright work, and kept them shining. Also, being the oiler, I tended the oiling system. But to me, the main part of the whole works was the flywheel and the releasing corliss valve gear.

The engines ran "over," and the Chief instructed me on starting them and putting the crank in a certain position by using the valve gear, hand operated. This running of the engines in only one direction kept me guessing. I reasoned it out: If I got the flywheel turning in the opposite direction by manipulating the valve gear by hand, and then dropped the latch into place, the engine would continue to run "under". I tried it. But each time the engine would groan, stop and then start in the proper direction. I decided I wasn't giving it enough steam, and so I proceeded to rectify my mistake. I was all set for the big test when along came the Chief. "Well, what are you up to now?" he asked me. When I told him my plan, he nearly jumped through the roof. Several days later he calmed down enough to explain what I was doing. He made me take a course in engineering so that I would know what I was working at.

Another bright idea occurred to me while I watched the vacuum pump on the jet condenser. At various times the vacuum would be lost, and hot water and steam would blow out through the vacuum breaker on the side of the condenser. Sometimes the loss of vacuum would be caused by the pump stopping, at other times by loss of water due to dirty screens in the suction intake. I reasoned that not enough air was getting into the condenser to make a vacuum. So I made a little pine wedge and drove it under the valve on the vacuum breaker. The loss of vacuum which ensued had the Chief and his assistants jumping all over the place trying to locate the trouble. When I ventured to tell one of the junior engineers what I had done, the storm of abuse so discouraged me that I nearly quit and left the engineers to look out for themselves.

I look back on these little incidents as expensive lessons in a long, hard but interesting thirst for knowledge.

Springfield Gardens, N. Y.

E L O'BRIEN

More on Bagged Tubes

IN JANUARY POWER, page 114, John Gorrie discusses "bagged" tubes. As member of National Board of Boiler & Pressure Vessel Inspectors, I know that at times the cause of bagging is apparent at once—at other times elusive. It is elusive when there is no scale condition but a clean split. Distortion may indeed not be an ordinary bag but the result of "blow" when the tube opened.

Common cause of bagged tube is the one in Mr Gorrie's article, usually found at the fire side of tubes exposed to radiant heat. Being near the fire, they form scale fastest and require turbining oftenest. They are the ones where resistance to removal is greatest. The cutters are sometimes moved back and forth many times to dislodge scale that almost always adheres tenaciously to lower part of tube.

Not infrequently a small distortion at the tube's fire side corresponds exactly to the shape of the scale patch. When a light is held at one end, tube appears clear to the eye at the opposite end, or at least clear enough. Because of the depression, the scale seems paper thin. Other things being equal, I believe this condition leads to bagging.

(Continued on page 182)

Changing your address soon?

You will help us give you the good service that is your due by notifying us at once of your change of address. Often the monthly issues of POWER go out of print almost immediately after publication, preventing us from supplying issues that may have been misdirected. Prompt notification of address changes that have been made or will be made prevent your missing a single one of the big valuable monthly issues of POWER.

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HOW TO SOLVE
Operating Problems with Correct Lubrication
1 TO PREVENT RING STICKING, A FILM OF OIL MUST BE MAINTAINED BETWEEN THE RINGS AND THEIR GROOVES
2 TO MINIMIZE RING AND LINER WEAR, A TOUGH OIL FILM MUST BE MAINTAINED BETWEEN THE RINGS AND CYLINDER WALLS

Get 2 Jobs Well Done

AS YOU SEE ABOVE, an oil film must be maintained in a Diesel (1) between the rings and their grooves, and (2) between the face of the rings and the cylinder wall. At these places the oil film is subjected to heat, pressure and oxygen. Inferior oil will oxidize, cook and form hard carbon deposits.

These deposits will cause ring sticking that results in costly wear, power-wasting "blow-by"!

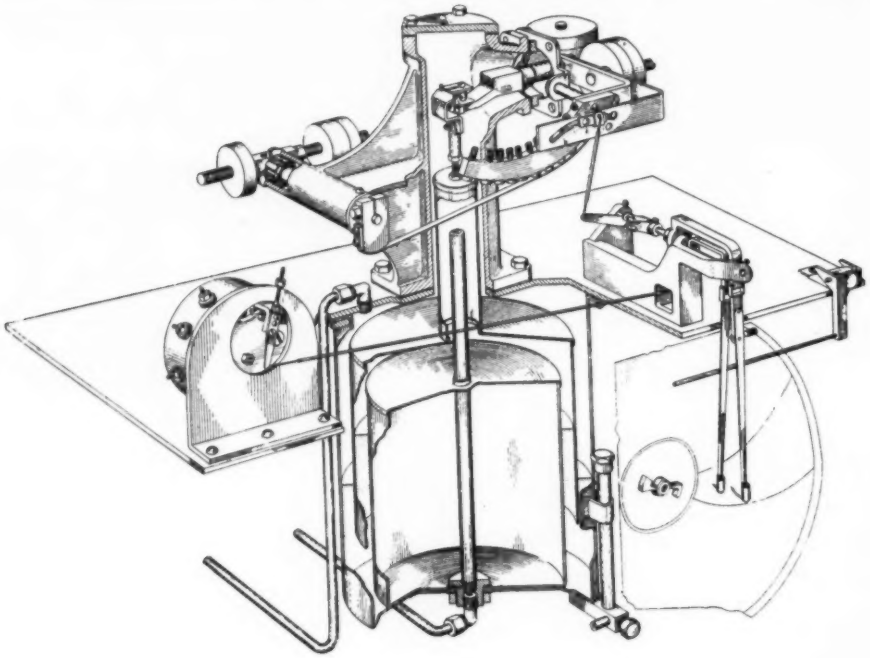
Gargoyle D.T.E. Oil Nos. 1-to-5 give maximum protection against deposits — both on pistons and rings. They have been specifically designed to meet the *severest* requirements of the intermediate and large size engines built and operated today.

GARGOYLE Lubricants

SOCONY-VACUUM OIL COMPANY, INC. — Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Southeastern Div. (Baltimore) • Magnolia Petroleum Co. • General Petroleum Corp.

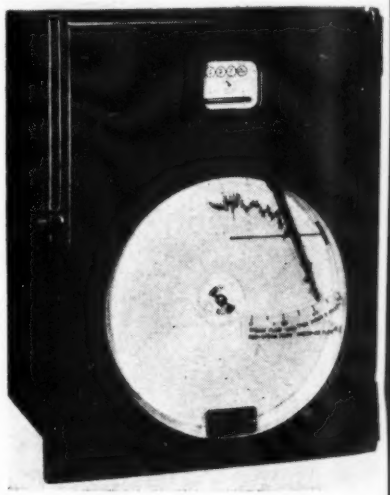
CALL IN SOCONY-VACUUM

WHAT'S NEW IN PLANT EQUIPMENT



Boiler Meter

EXACTING FIELD TESTS have been made on this new steamflow-airflow measuring instrument. It consists of an electric recording and integrating steamflow element which is combined with an oil-sealed bell type recording airflow meter. Two recordings, made simultaneously on a 12-in. chart, show steam flow from boiler and rate of air flow to furnace for combustion. Regardless of load carried by boiler, when furnace is receiving the proper amount of air for maximum combustion efficiency, the airflow pen recording in blue coincidentally with the red steam flow pen, gives operator an all's-well picture, read at a glance. Conversely, when operating conditions are not right, meter guides operator immediately to proper adjustments. A third pen, recording flue-gas temperature or steam pressure, can be added to provide complete boiler performance information on the same 12-in. chart. Meter may be either wall- or flush-mounted on a steel panel. Meter bodies are available in a series of models to cover all ranges of differential and line pressures. Company claims nine features: (1) direct-reading recorder; (2) continuous direct-reading watt-hour type of steamflow integrator, having a cyclometer easy-to-read dial; (3) adjustable zero-setting feature that eliminates need for exact mercury content in steam meter body; (4) ratio adjustment to accommodate steamflow-airflow changes; (5) adjustable cam screws permitting adjustments of airflow reading at each chart point; (6) provision for easy field, full range adjustments of airflow meter (½ in. to 5 in. of water); (7) completely sealed oil chamber provided by the single bell design; (8) exceptionally high operating power provided by oversized bell; (9) simplicity in design and easy unit removal of complete mechanism for maintenance. *Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, 47, Ill.*

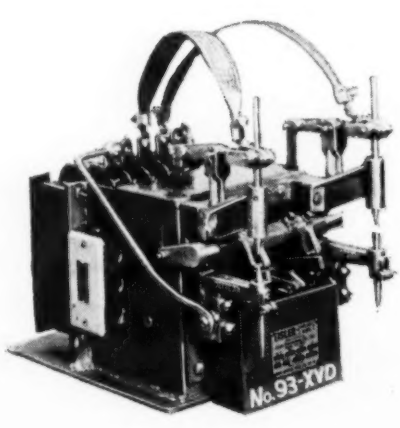


Pulsation Dampener

ASHCROFT PULSATION DAMPENER, Type 1106, for use with pressure gages subject to severe pulsations and rapid fluctuations. Can be employed for all pressures up to 5000 psi and for air, water, oil or steam wherever dampening device is needed. Small Monel plunger oscillates freely in a cylindrical hole in bushing. Clearance between plunger and hole is just sufficient to give the proper throttling action. Free plunger movement makes device self cleaning. Company states that it eliminates excessive or harmful pointer vibration, saves wear on gage movement, and saves time in reading true mean pressure. Manufacturer says it helps keep the gage in calibration and prolongs gage life. *Ashcroft Gauge Div, Manning, Maxwell & Moore, Inc, Bridgeport, Conn.*

Double-Electrode Spot Welder

TWO TYPES of a duplex-jaw spot welder designed for welding light gage sheet and wire. Each unit consists of two independent small welding machines built together with one transformer and rheostat. Illustration shows duplex welder supplied with vertical press arrangement. Both are foot operated by means of two treadles and chains. Made in sizes from ½ to 3 kva. Transformer in both types has five secondary tap connections providing five different heat positions. Machines are built for single phase ac, 110, 220 or 440, 25 to 40, 50 and 60 cycles. *Eisler Engineering Co, 740 South 13th St, Newark, N. J.*



Load-Center Unit Substations

LOAD-CENTER UNIT SUBSTATIONS for semihazardous locations in oil refineries, chemical plants, and other plants having similar conditions, available in

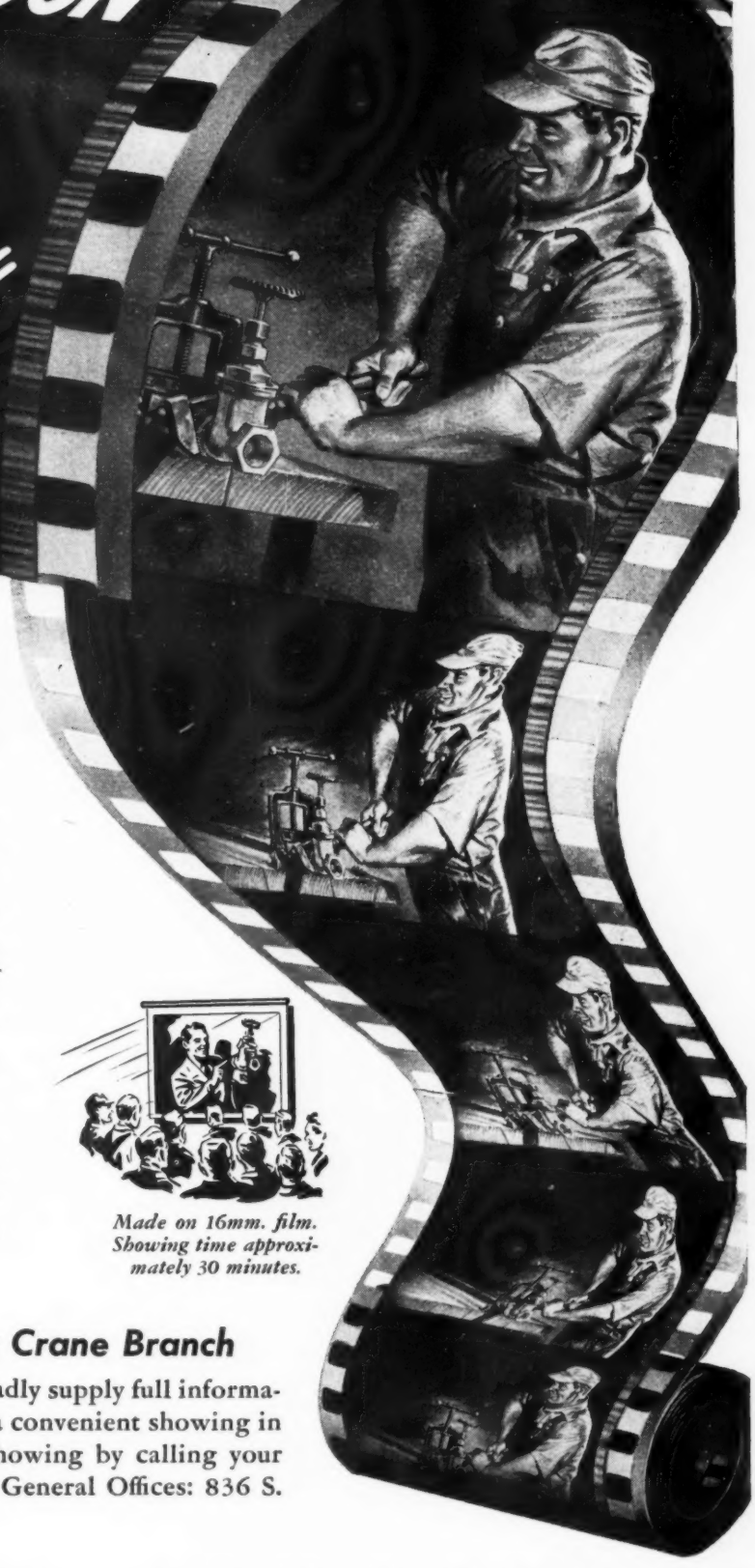
(*Continued on page* 186)

READY SOON

FOR SHOWING IN YOUR PLANT

"PIPING POINTERS"

A NEW SOUND MOTION PICTURE FOR MAINTENANCE WORKERS



STILL greater shortages of man power and reduced supplies of vital equipment are threatened by war. Yet no plant can operate efficiently without adequate care for its piping systems.

Seeing and hearing this film will give new, inexperienced maintenance workers a quicker grasp of their jobs—a clearer understanding of how to handle valves, fittings, and piping accessories to keep pipe lines flowing with fewer interruptions. To "old timers" it will recall many forgotten "tricks of the trade."

As the leading maker of valves and fittings, Crane Co. offers this film in today's emergency—to share with all industry—its 88-year experience in flow-control engineering. "Piping Pointers" will be available for showing in any plant, trade school or industrial training center.

Made on 16mm. film. Showing time approximately 30 minutes.

Showings Arranged by Your Crane Branch

The Crane Branch serving your area will gladly supply full information about "Piping Pointers" and arrange a convenient showing in your plant. Reserve a date for an early showing by calling your Crane Representative today. CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.

CRANE VALVES

Belly Boiler . . .

LIKE MOST KIDS, I had an uncle who told stories. He'd bummed his way all over America—so some of his stories were pretty tall. Thus when he told me that you couldn't boil an egg on Pike's Peak, I wobbled between laughing at the whole story and trying to figure out what could be wrong with the egg. But I worried. . . .

I know more about pressure and temperature now. All the same, a recent news item floored me. For some reason, I've been reading about all the methods suggested for getting drinking water when your bomber or fighter conks out in the middle of the ocean. Water is too heavy to make it possible to carry much. There's all that water around you, and not a drop to drink—unless you can distill it. They've tried chemicals, and squeezing chopped fish. But now comes an inventor who must be an uncle like mine.

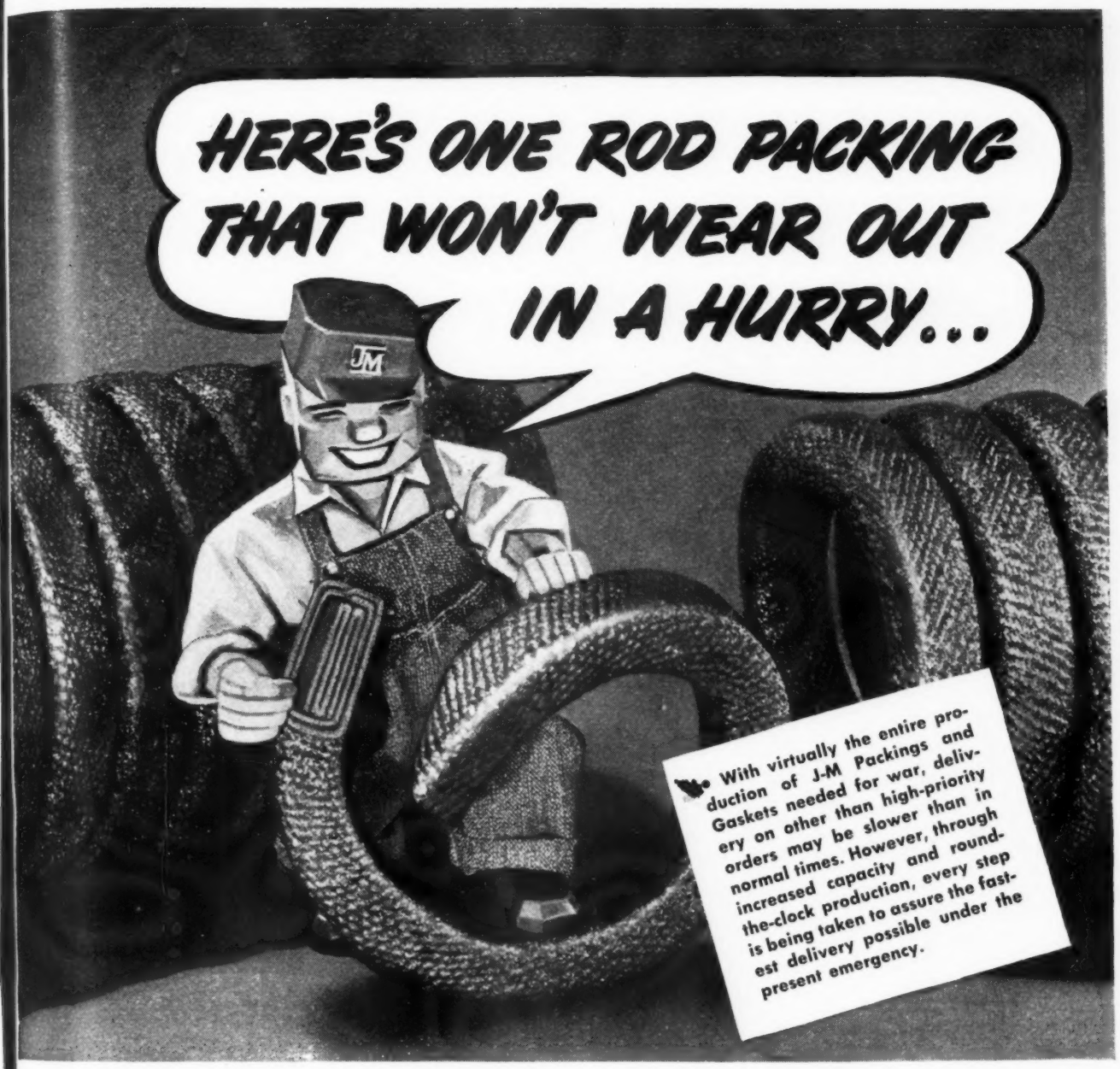
He's Dr. Karl Sollner, of the University of Minnesota, whom the Nazis chased from Germany ten years ago. With a Dr. Maurice B. Visscher, he's invented a "belly still." You have a pint-size flat copper boiler strapped to what the teachers call your abdomen. Connected to it is a hand-cranked vacuum pump to reduce boiler pressure, and a condenser to trail in the sea. You provide the heat—probably plenty of it if you crank that pump under a hot sun. Anyway, it produces 24 oz of pure water a day.

Well, there it is—and I'm a kid again. The inventors go right on to say their next still will go on a jeep engine and make drinking water from swamp water or any other unfit supply.

My training tells me it can be done, but my suspicions tell me I'm getting my leg pulled. Could be—but far crazier ideas than that of yesterday are today's commonplaces. Galileo, Newton and Fulton, for example, didn't exactly get contemporary credit for being sane. Maybe I'd better be a little less misbelieving, and catch up with tomorrow.

George Edwards

Engineer


HERE'S ONE ROD PACKING THAT WON'T WEAR OUT IN A HURRY...
JM
With virtually the entire production of J-M Packings and Gaskets needed for war, delivery on other than high-priority orders may be slower than in normal times. However, through increased capacity and round-the-clock production, every step is being taken to assure the fastest delivery possible under the present emergency.

J-M KEARSARGE LASTS LONGER . . . CUTS RE-PACKING COSTS

For continued efficient service against high-pressure steam, you can't beat this rugged rod and plunger packing.

Its unique folded construction provides natural resiliency and forms a reservoir for the preserving lubricant, keeping the packing pliable in service.

Additional resiliency is provided by a rubber expansion back in the center block. And resistance to wear is assured by a double wrapping of asbestos cloth.

You can use Kearsarge Rod Packing, together with other packings and gaskets in the complete Johns-Manville line, to minimize equipment shutdowns . . . save much of the expense and loss of production caused by too-frequent re-packing.

For details, ask for the J-M Packing Catalog, Johns-Manville, 22 East 40th Street, New York 16, New York.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

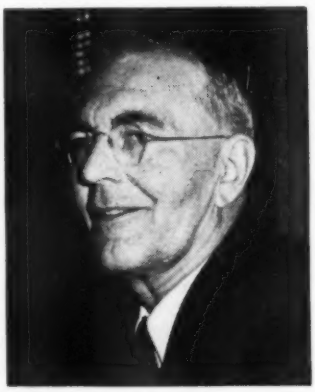
THERE'S A DISTRIBUTOR NEAR YOU

POWER LINES

Personal notes, items of general interest, the latest from Washington—all the news that is news in the power field

NAPE NATIONAL CONFERENCE HELD AT BUFFALO

War has brought many changes to the annual assembly of the National Association of Power Engineers. The last convention was held at Baltimore, in 1941, no meeting being held in 1942. This year's gathering at the Hotel Statler, Buffalo, N. Y., Sept 1-3, was discreetly planned and conducted as a "conference" to avoid any strain on

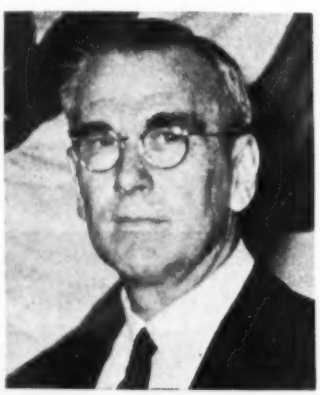


C A Bland, Des Moines, president

wartime manpower and transportation. Attendance was kept well below peacetime levels and no attempt was made to hold an equipment show although some manufacturers displayed samples.

Following the traditional routine, Conference Chairman and past National President George M Diebold opened the conference in a session that featured addresses by: a representative of Buffalo's mayor; Col Wm Kelly, president, Buffalo, Niagara and Eastern Power Corp; National President

(*Continued on page* 192)



W D Lewis, New York, vice president

Solid Fuels Administrator Ickes has ordered Appalachian coal operators to supply **the iron and steel industry** and other vital metallurgical users before filling other orders. The plan, issued as Solid Fuels Regulation No. 4, by a producers' committee, provides also that producers reduce other shipments pro rata to supply favored users and try to get greater reductions than those the pro-rata plan imposes on users with ample stockpiles.

Producers in bituminous districts 1, 2, 3, 4, 6, 7 and 8, the Appalachian region, are to fill metallurgical orders first, then orders in the Lakes region. **Where production is less than requirements,** Solid Fuels Adm will apportion deficiency to be filled by various districts.

Purchasers and producers are urged to reduce pro-rata shipments as often as necessary to those having on hand more than a "reasonable number." They may prohibit or restrict shipment to certain customers. No one is liable for default on contracts because of compliance with the regulation.

✪ ✪ ✪

Six Chinese engineers are seeking duration jobs with electric companies. They are completing courses with TVA and late this year will be available for service of a year or longer. They are from 30 to 36, experience from seven to 14 years. **Four are electrical engineers,** one a **civil** and the other a **mechanical engineer.** All hold B S degrees from Chinese universities. One did graduate work at Harvard, another at California Institute of Technology. They are specializing in **hydro power plant civil engineering, power distribution** and **sales, power distribution substation work,** and **electric power plant engineering.** At TVA, most of them are getting experience on **power plant design, construction** and **operation.**

At the request of National Resources Commission, the Council of Electric Operating Companies is trying to place the men and has written a dozen companies about them. They want broad experience in specified phases of electric utility operation.

F H Rosencrants, vice president, **Combustion Engineering Co, Inc,** and a recognized international authority on steam power plants and boiler design, died suddenly at his home in Scarsdale, N. Y., August 26.

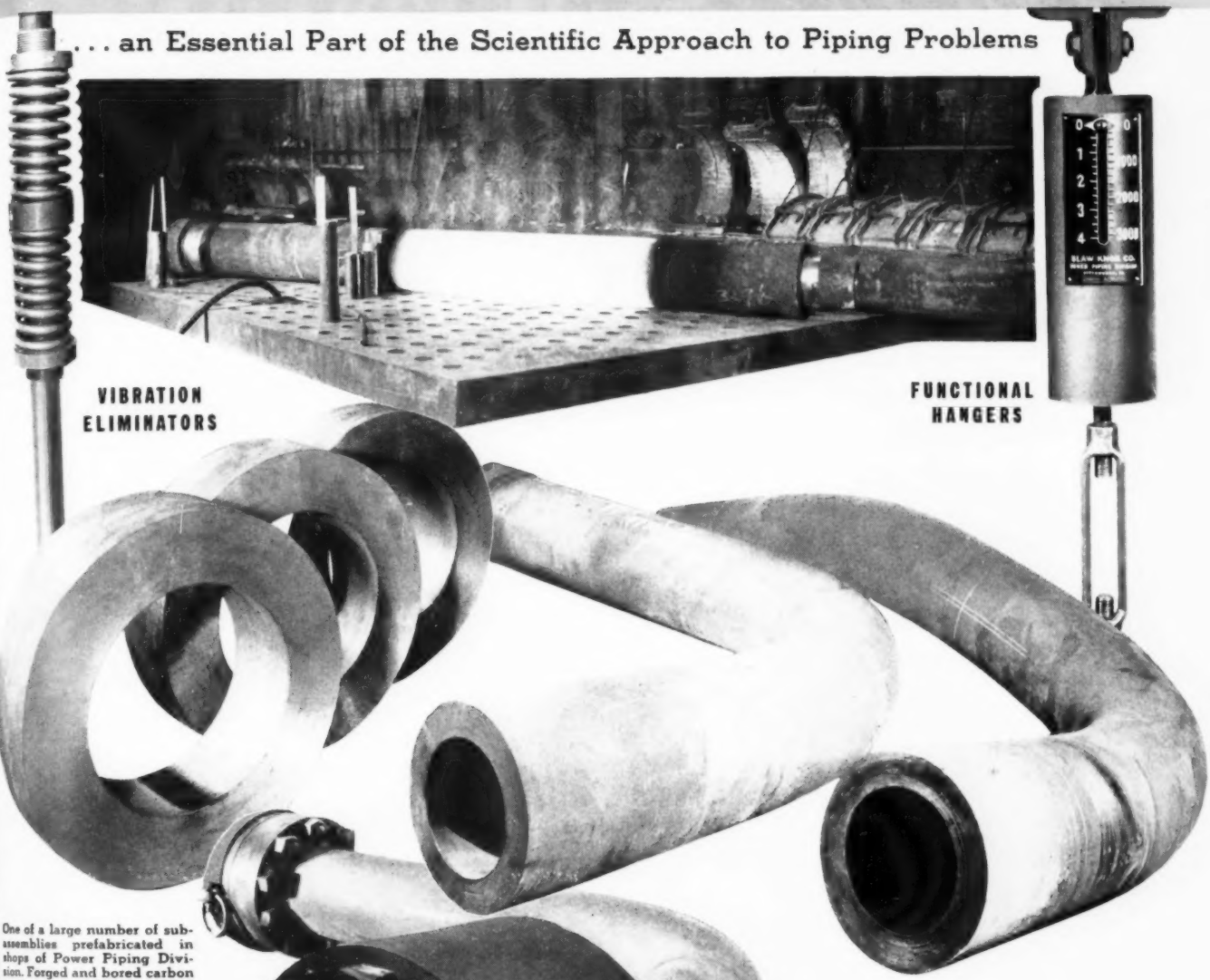
A graduate of the University of Nebraska in mechanical engineering and later professor at Oregon State College, Mr Rosencrants subsequently became associated with the design of utility power plants, serving as mechanical engineer of the Texas Power and Light Co, and, from 1918 to 1924, of the Electric Bond & Share Co. During the last two years of his service with the latter company he was in charge of design of steam power stations.

In 1924, he went to England to become Director of Engineering of International Combustion Engineering Co, Ltd, London. He served in this capacity for the next six years during which he supervised design and construction of notable steam power installations in Great Britain and many other countries. Returning to the U. S. in 1930, he became vice president of Combustion Engineering Co, Inc, New York. He was in charge of some of the company's most important activities, including the development of the standard VU design of steam generator for a wide range of capacities, and the development of chemical recovery units for pulp mills. He was also identified with the design of the first large forced-circulation boiler in this country—the 650,000-lb-per-hr 2000-psi unit placed in service at Somerset Station of Montaup Electric Co about two years ago.

In recent years he has been in charge of the company's marine department, his able administration of which has been an important factor in handling a vast volume of work for the Maritime Commission and the Navy.

PREFABRICATION

... an Essential Part of the Scientific Approach to Piping Problems



One of a large number of subassemblies prefabricated in shops of Power Piping Division. Forged and bored carbon steel piping, 10" ID. 17½" OD. Flanges 17⅝"x31½"x 8¼". For 14,000 ton Hydraulic Forging Press. Photograph taken during preparations for testing.

PREFABRICATION

Power Piping prefabrication of subassemblies, heat treated and stress relieved under rigid engineering control, means exact adherence to specifications, negligible field welding and simplification of erection.

Use of Power Piping Division facilities for prefabrication of piping systems of any character helps to overcome the problem of equipment shortage and enables delivery and erection to be made within reasonable limits.

A consultation with Power Piping engineers will often result in practical recommendations for the substitution of materials to relieve bottlenecks due to material shortages.

ERECTION

Highly developed procedures employed provide the last word in economical erection. The use of Functional Hangers and Vibration Eliminators adequately control the behavior of your piping system.

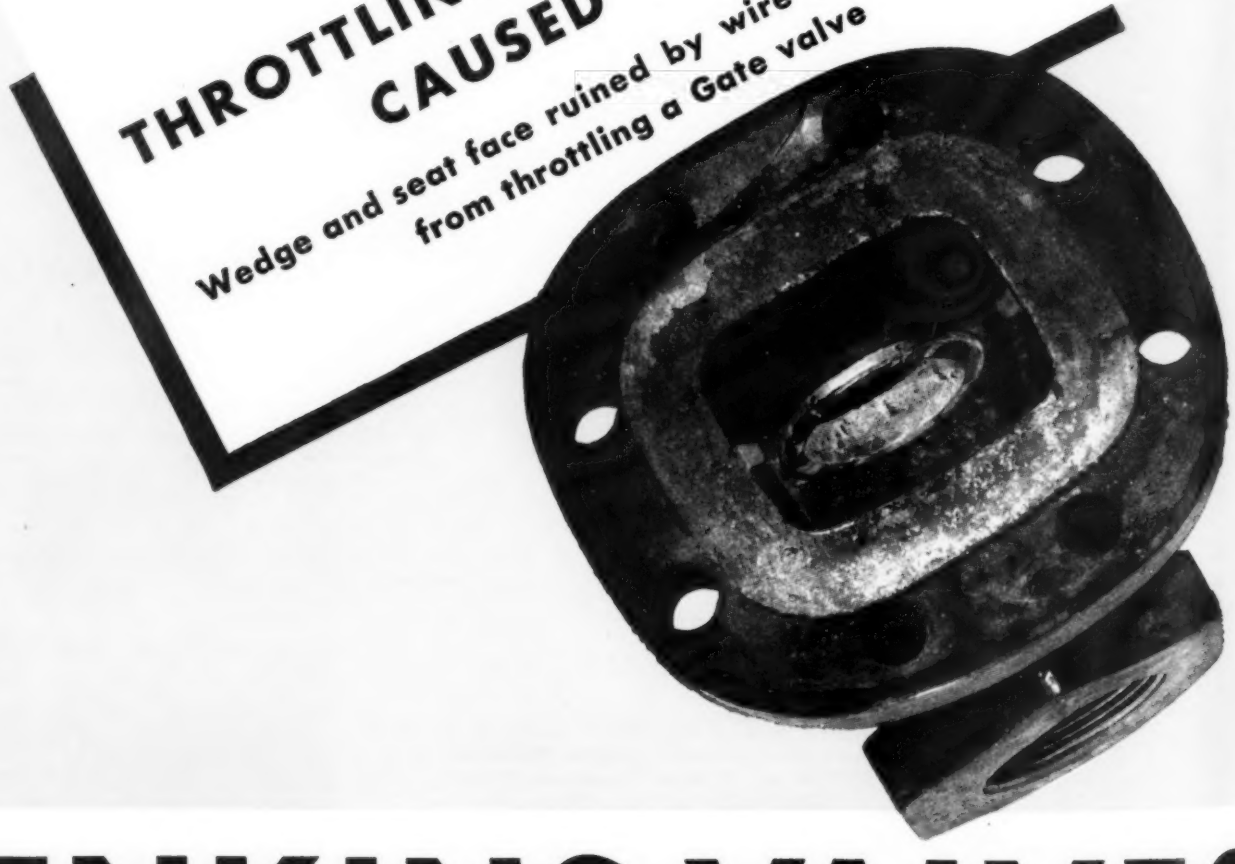
BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

The correlated use of FLEX-ANAL CHARTS and HANGER BULLETIN 1863 saves time in engineering man power which can be devoted to other useful purposes. Copies of these books can be obtained through a request on your business letterhead.

Prevent Valve Failure

THROTTLING A GATE VALVE CAUSED THIS!

Wedge and seat face ruined by wire drawing effect from throttling a Gate valve



JENKINS VALVES

before it starts!

IT CAN'T HAPPEN TO YOUR GATE VALVES IF . . .

IF you use Gate valves only for services for which they are designed, you will avoid needless destruction of valves. For example, gate valves are not intended for throttling purposes. The ruined seat faces pictured on the opposite page show the result of using a Gate valve partially open to regulate flow. Wire drawing effects are an almost certain result of such misuse, when Gate valves are used in steam, condensate, or other services where foreign matter may be present. For throttling service a Plug Seat Globe valve is best, but a Renewable Disc Seat Globe valve can be used if equipped with Jenkins Throttling Nut.

Similar destruction of seating faces is often caused by scale and other foreign matter lodging between the seat ring and wedge faces. And, you can take steps to minimize that possibility. When installing valves and piping, have workers look into them, see that they are clean. After valves are installed, flush them out periodically . . . close the valve so a small flow under greater pressure is obtained to dislodge any foreign matter that might be in the valve.

Most important is regular inspection of valves by an experienced man. Usually, leaks warn of trouble before parts are seriously damaged. At the first sign of leaks, action should be taken to remove the cause, and repairs should be made before the destruction progresses beyond the repairable stage.

In peacetime it is wise management to pay close attention to valve conservation. It pays handsome dividends.

In today's emergency, valves *must* be kept in efficient operation. Failure of control over vital power and fluids may interrupt the victory-pace of production.

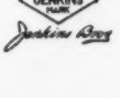
Also, neglect of valves is sure to waste metals which are urgently needed for war weapons. New valves can be obtained only for certain uses which are vital to the war effort. Many valves in present use must be kept in service until the war is won.

The well-known "ounce of prevention" is worth a pound of cure in valve maintenance. Inspect them frequently, systematically. Repair or replace worn parts before serious deterioration begins. Be sure new maintenance men are thoroughly instructed. Select new valves for approved construction with extra care, and see that they are installed properly.

Check up on your program of valve conservation and see that it is adequate to the present emergency. Jenkins Engineers will give you complete cooperation.

• • •

Jenkins Bros., 80 White Street, New York 13, N. Y.; Bridgeport; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.



For every industrial, engineering, marine and power plant service

BRONZE IRON STEEL

© POWER

Portable Fire-Extinguisher Types

TYPE	PLAIN WATER*		SODA-ACID	LOADED STREAM	FOAM	CARBON TETRACHLORIDE		CARBON DIOXIDE		DRY COMPOUND
	Pump-Tank	Cartridge				Pump	Stored Press	Small	Large	
Size	5-gal	2½-gal	2½-gal	2½-gal	2½-gal	1-qt	1-gal	7½-lb	15-lb	15-lb
Weight, lb	65	35	35	45	35	7	30	35	45	40
Method of operation	Pumped by hand	Inverted	Inverted	Inverted	Inverted	Pumped by hand	Valve opened	Valve opened	Valve opened	Valve opened
Effective range, ft	30 to 40	30 to 40	30 to 40	30 to 40	30 to 40	20	20 to 30	6	8	6 to 16
Time to empty	1.5 to 2 min	1 min	1 to 1.5 min	1 min	1 to 1.5 min	45 sec	1 min	20 to 30 sec	35 to 45 sec	20 to 25 sec
Underwriters' classification	A-1	A-1	A-1	A-1, B-2	A-1, B-1	B-2, C-2	B-2, C-1	B-2, C-1	B-1, C-1	B-1, C-1
Principal extinguishing agent	Water		Water	Water & special chemical	Foam bubbles containing inert gas	Inert gas, after liquid vaporized by heat		Inert gas		Dry powder releasing inert gas
Effect produced	Cooling		Cooling	Cooling, oxidation inhibiting	Blanketing	Smothering		Smothering, cooling		Smothering
Conductor of electricity	Yes		Yes	Yes	Yes	No		No		No
Need of freezing protection	Yes		Yes	No	Yes	No		No		No
Materials used										
Main charge	Water	Water	Water	Water	Water	Carbon tetra, containing antifreeze & lubricant		Liquid carbon dioxide		Bicarbonate of soda, specially treated
Supplementary	None	Gas cartridge	Sodium bicarb 1.5 lb, sulphuric acid 4 oz	Special alkali-metal salt	Aluminum sulphate, sodium bicarbonate, foaming agent	Compressed air (for stored-pressure type)		None		Carbon-dioxide cartridge
Maintenance, annual	Partial discharge, then refilling	Water-level check, gas-cartridge check by weighing	Complete recharge	Complete recharge	Complete recharge	Partial discharge, then refilling		Leakage check by weighing		Gas-cartridge check by weighing
Effect on fires										
A—wood, rubbish	Excellent		Excellent	Excellent	Good	Poor		Fair		Fair
B—flammable liquids	Poor		Poor	Fair	Excellent	Fair		Excellent		Excellent
C—electrical	Poor†		Poor†	Poor†	Poor†	Good		Excellent		Excellent
D—vehicles	Limited		Poor	Poor	Poor	Good		Excellent		Excellent

* These water-type extinguishers suitable also for antifreeze compound, thus avoiding need for other cold-weather protection.

† These types not recommended for fires in electrical equipment; however, for some kinds of electrical fires, such as in switching equipment, wiring, motors, transformers, the quenching and cooling effect of large quantities of water or solutions containing mostly water is necessary; in these cases, equipment and circuits should be de-energized before using such extinguishers.

From "Handbook of Fire Safety Practices," Ebasco Services, Inc.

COPES

Score: 11 Boilers 11 Flowmatics

5-1942

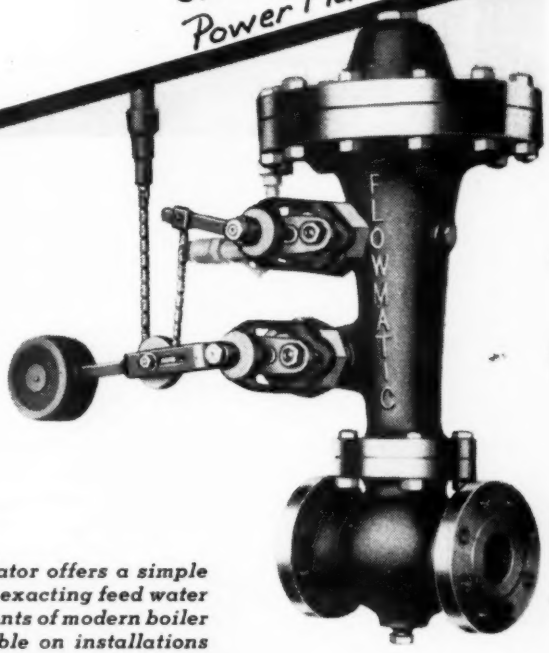
Gentlemen:

Regarding the operation of Copes FLOWMATIC REGULATORS this advises we are ~~are not~~ obtaining satisfactory results.

Remarks: We ordered three more Copes Flowmatic Regulators. Score - 11 Boilers - 11 Copes Flowmatic Regulators.

Wyman-Gordon Co.

By Max R. Boye
Chief Engineer
Power Plant



IN 1941, the Wyman-Gordon Company, Ingalls-Shepard Division, Harvey, Ill., installed their first Flowmatic Regulator. Confronted with the problem of maintaining close boiler water level control in spite of severe load fluctuations produced by forging operations, they found Flowmatic to be the correct solution. As Mr. Max R. Boye, Chief Engineer of the Power Plant, has remarked on the return card of our routine check-up, the score is now 11 Boilers, 11 Copes Flowmatic Regulators.

Proved performance of this kind accounts for the remarkable record of more than 825 Copes Flowmatic installations since its introduction only 5 years ago.

The Copes Flowmatic Regulator offers a simple reliable means of maintaining exacting feed water control geared to the requirements of modern boiler design. It is especially valuable on installations subject to severe load fluctuations. For details, write for Bulletin 429-A.

OVER **60,000** COPES FEED WATER REGULATORS IN SERVICE

NORTHERN EQUIPMENT COMPANY • 1031 Grove Drive, Erie, Pa.
Feed Water Regulators • Pump Governors • Differential Valves • Liquid Level Controls • Reducing Valves and Desuperheaters
BRANCH PLANTS IN CANADA, ENGLAND • REPRESENTATIVES EVERYWHERE

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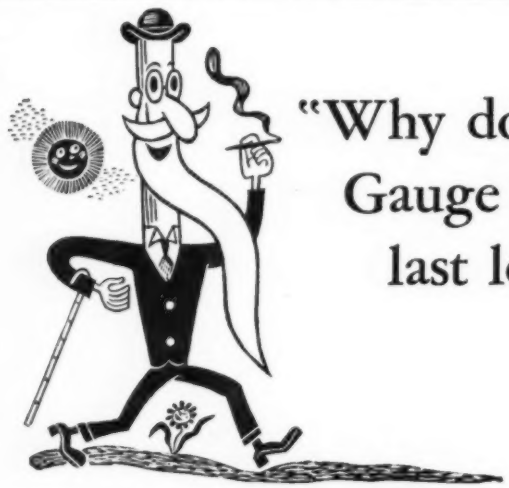
A reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.



"Why do Pyrex Gauge Glasses last longer"

That question is so often asked that the answers may be of general interest to plant engineers and operators.

Few people realize how many different kinds of glass can be made, or how many different characteristics it can have. Corning has made over 25,000 varieties—makes 700 regularly. One of these is a composition specially suited for gauge glass service.

This particular type is a PYREX brand Borosilicate Glass with an extremely low co-efficient of expansion (.0000032 between 34° and 700° Fahrenheit). Capable of being heated to 600° F. and plunged into ice water repeatedly, without damage, it is completely indifferent to all ordinary plant temperatures.

Furthermore, this PYREX brand Glass is extraordinarily resistant to corrosion. Under constant boiling in concentrated sulphuric or hydrochloric acid, PYREX brand Glass dissolves almost imperceptibly for the first few hours and then reaches a point of practical stability. This feature alone would largely account for the long-life records of PYREX Gauge Glasses.

The third important characteristic of PYREX brand Gauge Glasses is their toughness and strength—rarely do they break from mechanical causes in boiler service.

If you do not now enjoy the economy of PYREX brand Gauge Glasses, specify them the next time you order from your dealer.

Corning Standard Gauge Glass

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

Lubricate Chain Drives

(*Continued from page 105*)

For chains lubricated by ring or disk oilers, use oil of approximately 325 SSU viscosity at 100 F. Because a fairly plentiful supply reaches the chain-bearing areas continuously—plus the oil's centrifugal throw—a relatively light-bodied oil may be used. It is superior to a heavier-bodied oil because it not only finds its way more easily into the chain's small clearance areas but it also better resists the oxidizing effects of agitation.

Inspect oil in the chain-inclosing case at least once a month. If it shows a tendency to thicken because of oxidation or impurities, drain case and replenish with fresh oil. For trouble-free operation and minimum chain wear, drain and change oil at least every six months.

One of the best ways to lubricate large high-speed chains is to bathe them in a medium-bodied oil by a circulating system, as in Fig. 12. Oil runs from the chain casing into a sump and is pumped to a distribution pipe above the chain's lower strand. Oil under pressure is sprayed onto the chain; excess falls to bottom of casing and returns to sump. For these applications an oil of 325 SSU viscosity at 100 F is satisfactory if a copious supply of cool oil can be delivered. Put a strainer in the pump suction and take care to prevent oil contamination.

New Method for High Speed

A new method has been developed for lubricating high-speed chains above 3800 fpm. Oil level in the inclosing case is maintained at about 0.25 in. below the chain's lowest point. When chain is running, its action on the air over the oil surface whips oil into a spray that is carried around and strikes a baffle in the casing top. From the baffle, oil flows into a trough that distributes it on the chain's lower strand.

Suggestions for selecting lubricants for chain drives, in the table at the beginning of this article, are based on the assumption that only high-grade straight mineral oil is used. Specially compounded oils on the market, however, have lubricating qualities superior to those normally found in straight mineral oils. These special oils may be used for chain drives if their additives do not reduce their resistance to oxidation. When oils that are not properly compounded are exposed to excessive

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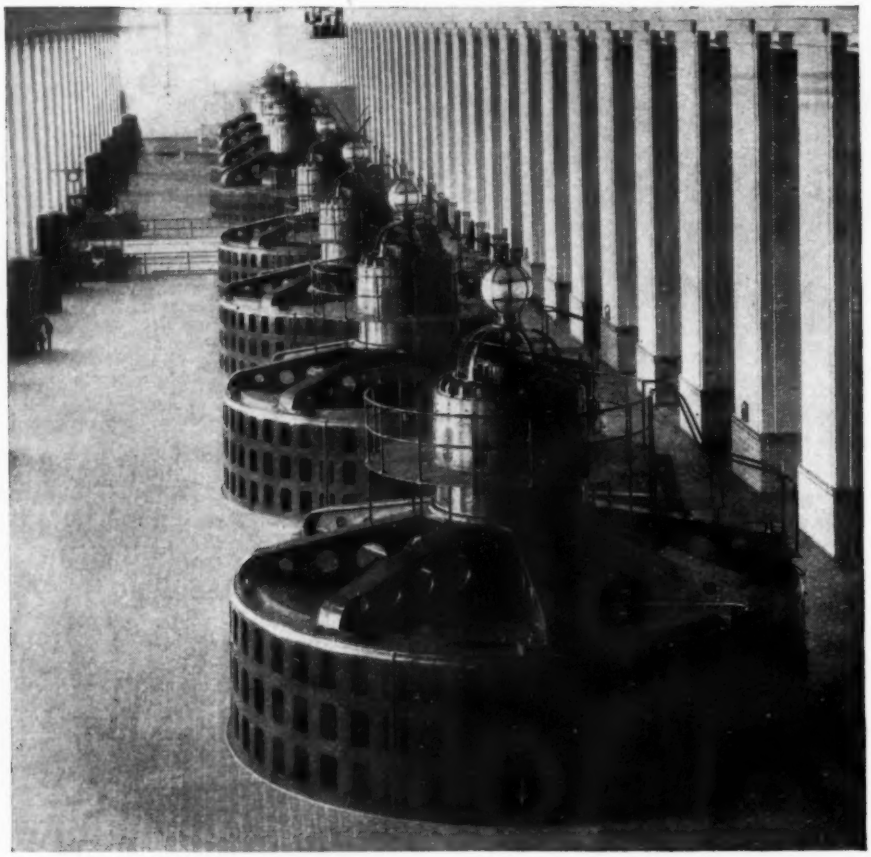

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aeration and heat, as in chain drives, sludge tends to form. For this reason, use special lubricants on the recommendation of a competent lubrication engineer.

Lubrication Hints

The following lubrication hints are helpful in getting maximum service from chain drives:

1. Keep sprockets properly aligned. Out of alignment, they distort bearing loadings and cause chain binding, both of which produce excessive wear in spite of good lubrication.

2. Keep sprockets well supported. A long chain's weight, added to the load pull on it, tends to distort shafting and bearings and cause misalignment of chain and sprockets.

3. Keep chains well lubricated. Arrange manual or mechanical lubrication so that chain is well coated with lubricant at all times.

4. Use oil-tight cases whenever possible. Dust, dirt and grit on chains cause as much trouble as lack of lubrication.

5. Keep chains clean. Remove them periodically, particularly those that operate without an inclosing casing, soak in kerosene and then with a brush remove all dirt, dust, grit and oxidized oil.

6. Drain oil from chain-inclosing cases. At intervals, depending on how many hours a day chains are used, renew the oil in their inclosing cases, even though it looks all right. Good lubrication of chain drives pays big dividends in long, reliable service.

7. Four causes of trouble are: *Foam:* oil level too high, chain speed too high for bath lubrication, or improper inclosing-case ventilation. *Oil leakage:* poor oil-case seals, too light oil, or pressure developed inside casing because of improper ventilation. *Excessive chain wear:* wrong oil, improper oil feed, oil contamination, sprockets out of alignment or chain improperly adjusted. *Excessive heat:* improper oil feed, lack of inclosing-case venting, oil level too low, oil too light permitting metal-to-metal contact at bearing surfaces, oil too heavy causing excessive fluid friction.

In preparing this article, the author acknowledges with thanks the assistance of Baldwin-Duckworth Chain Corp. Springfield, Mass.; Diamond Chain & Mfg Co, Indianapolis, Ind.; Dodge Mfg Co, Mishawaka, Ind.; Jeffrey Mfg Co, Columbus, O.; Link-Belt Co, Chicago, Ill.; Morse Chain Co, Ithaca, N. Y.; Ramsey Chain Co, Albany, N. Y.; Stephens-Adamson Mfg Co, Aurora, Ill.

NO. 9 OF A SERIES
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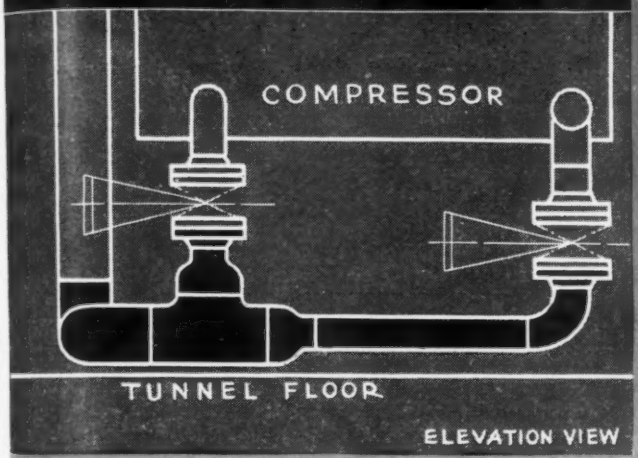
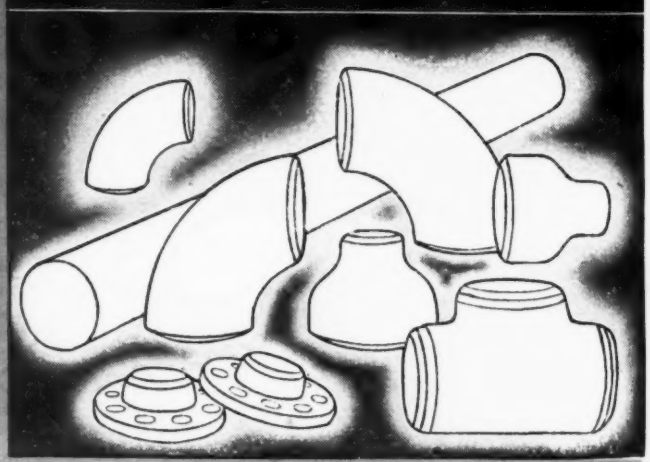
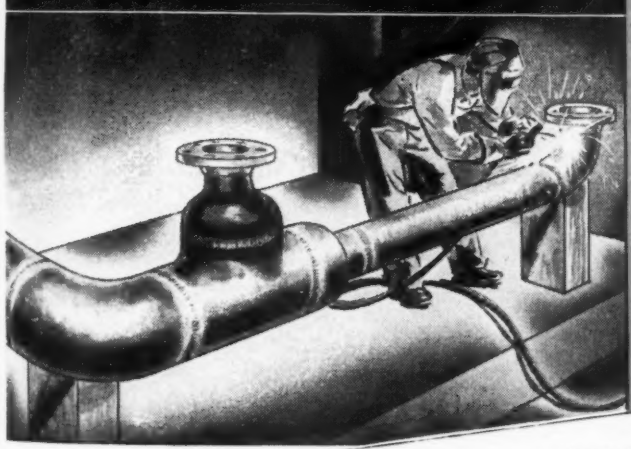
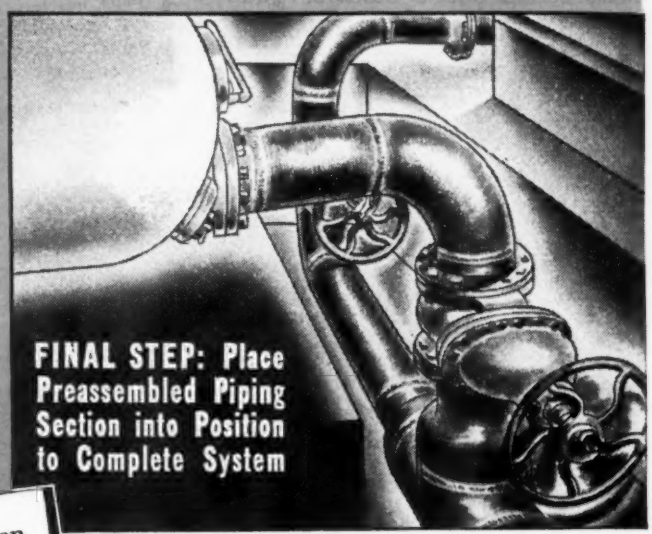


1st STEP: Assemble Pipe and Tube-Turn Fittings



2nd STEP: Preassemble Section in the Shop





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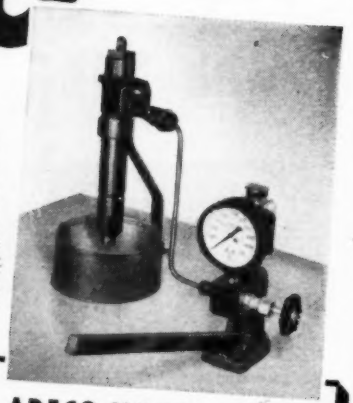

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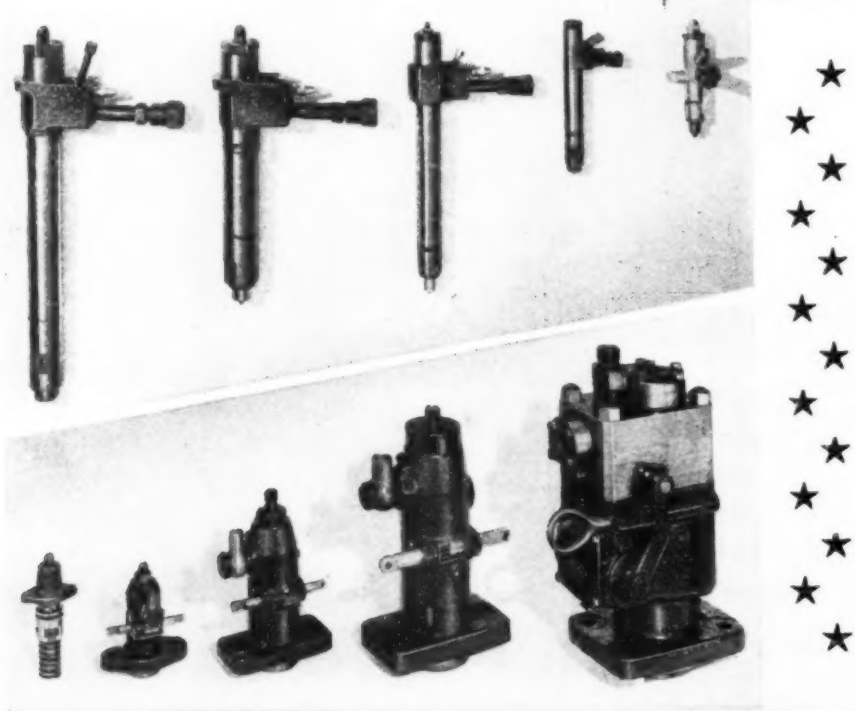
Throughout the diesel industry, Adeco stands for the finest in fuel injection equipment. Years of experience in pioneering equipment for America's diesel needs have resulted in an outstanding line of fuel injection pumps, nozzles and nozzle holders. Today's performance of this dependable equipment merits your confidence for tomorrow's requirements.



AIRCRAFT & DIESEL EQUIPMENT CORPORATION
4401 North Ravenswood Avenue • • Chicago, Illinois

Keep Head Pressure Down

(*Continued from page* 101)

acid to remove scale coating. A good cleaning job pays dividends in power savings.

High condensing pressure caused by insufficient cooling water comes from clogged water lines, water shortage, or water that is not cool enough. Clean strainers frequently. If an evaporative condenser or a cooling tower is used, keep the water pans clean. Maintain a constant check on the quantity of water flowing. For ammonia jobs, use 4 to 5 gpm per ton of refrigeration; for Freon-12 plants, 2 to 3 gpm per ton will do. Figures are based on 70 F water entering the condenser. Always regulate water flow so that benefits secured by circulating a large quantity offsets pumping costs. Anything above or below this is false economy.

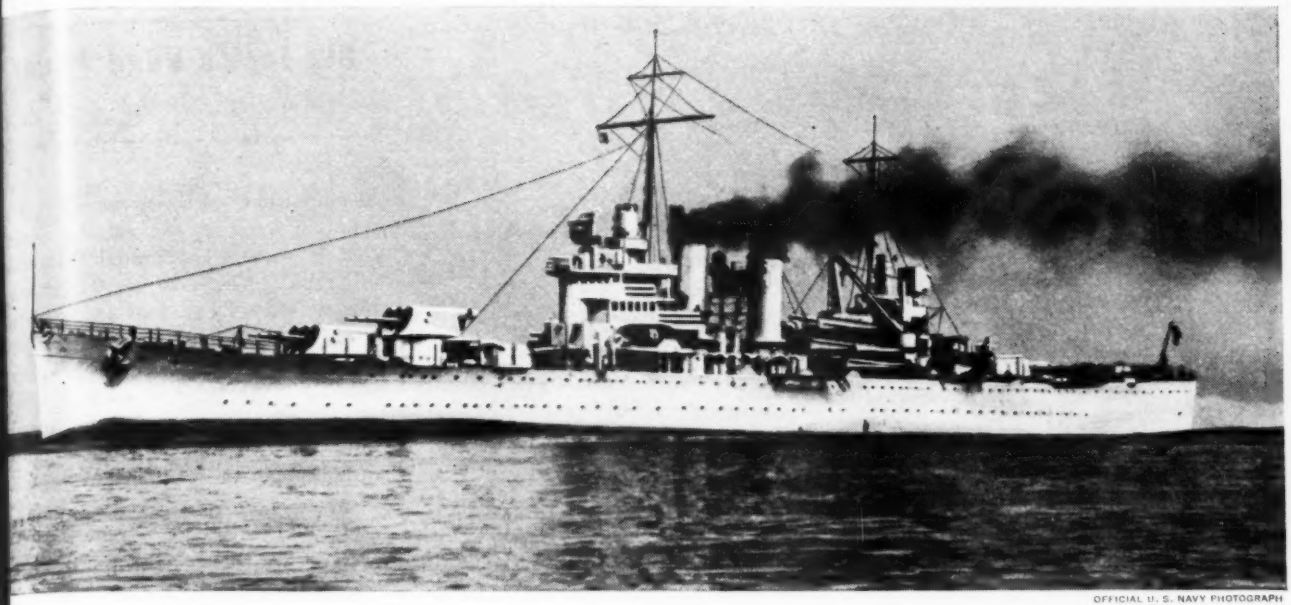
Evaporative-condenser head pressure rises above its normal value (based on 75 F wet-bulb temperature) on days of high wet-bulb temperature. A correctly engineered cooling tower cools its water through about a 10-F range with a 5-F approach to the existing wet-bulb temperature. Thus, in summer, if wet-bulb temperature is 75 F. and water leaving the condenser for the cooling tower is 90 F. the cooling tower should lower water temperature to about 80 F.

Cooling-Tower Troubles

Lack of deck surface from inadequate design or rotting away of wood structure may cause poor functioning of a cooling tower. Sometimes the tower becomes airbound. Adding more water sprays often alleviates this trouble.

Lack of condensing surface also causes high condensing pressures. Condensing surface should always be balanced against condensing load. Frequently in buying a condenser an engineer is overruled by the owner who wishes to get by on the smallest initial investment, forgetting that in the long run higher operating costs result if condenser is not the proper size.

Most popular condenser at present is the shell-and-tube unit, which offers from 7½ to 10 sq ft of condensing surface per ton of refrigeration. In some localities, where water is cold, free from mud and shows little or no scaling qualities, surface area can be decreased. A plant engineer should always check condensing surface against plant tonnage.



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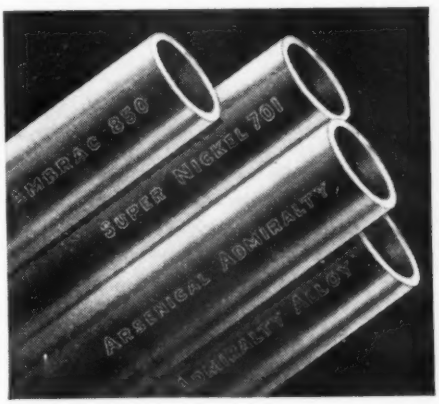
U.S.S. Boise returned with her *original* Condenser Tubes

How the *U.S.S. Boise* triumphed in sending six Jap warships to Davy Jones' locker is history. How this gallant ship then limped home unescorted—*under her own power*—is more history.

That her original condenser tubes were still serviceable is a "detail" not likely to be included in most accounts of her remarkable feat. But we remind you that she went into the epic Coral Sea battle with the Ambrac Condenser Tubes which were originally installed in 1936.

Today The American Brass Company is supplying for naval construction large amounts of copper-nickel alloy condenser tubes, the best alloy to meet the severe service imposed on the condenser of a fighting ship.



Condenser Tubes, in a wide selection of special-purpose alloys developed through long years of experience, are made by The American Brass Company. We are equipped to render engineering assistance on problems involving their use. You'll likely find our 58-page manual on Anaconda Tubes and Plates both interesting and helpful. If you haven't a copy, just ask for Publication B-2. 4395

Well made tubes of the right alloy will cut repair time losses at this critical period when lost time cannot be replaced.

Anaconda Condenser Tubes

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The dangers of reduced efficiency in plant operations due to faulty cleaning of pre-fabricated piping sub-assemblies cannot be too highly stressed. In Associated shops ALL fabrications, regardless of kind, size or shape, undergo our standard cleaning operation. Pipe bends are turbine-cleaned. This assures the dispersement of all foreign matter such as loose dirt, encrusted sand and scale, etc. Clean piping pays dividends. Associated piping is always clean.

Use our organization, experience, skill and most modern equipment, to supply your needs in power piping.

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2332 EAST 38TH STREET
LOS ANGELES, CALIFORNIA

Big Inch's Huge Pumps

(*Continued from page 77*)

incoming line to the suction of the first pump. Pumps are set side by side so that flow is straight through them when all three operate in series. A 16-in. line between the pumps leads into an 18-in. station-bypass line, as in Fig. 5. The station loop then connects with the mainline loop through 18-in. gate and check valves. This piping-and-valve arrangement permits any one, two or three pumps to operate individually or in series. It also provides maximum flexibility of control with a minimum of gate and check valves; the latter require most maintenance.

All drain lines for pumps and piping are taken to a sump tank from which a small pump discharges back into the suction line behind the strainer. Pressure bleedoff lines from the pump stuffing-box pressure-reducing bushings can be discharged either to the sump or to the suction intake line. All 24-in. valves for the project were built by the Darling Valve & Mfg Co. and the smaller valves by Walworth Co and Ludlow Valve Mfg Co.

Other Pumping Plants

In addition to the pumping plants on the 24-in. line, there is a plant, at Lambertsville, N. J., that will deliver 200,000 bbl per day through the New York 20-in. branch. An emergency pumping plant, at Bound Brook, N. J., and another, at Lansdale, Pa., can put the full capacity of the 24-in. line into New York. An emergency plant, at Chester, Pa., will deliver full capacity of the 24-in. line through the Philadelphia 20-in. line, when necessary. In each of these plants, the three pumps are rated at 300,000 bbl each day against 206-ft head, are built for a test pressure of 500 psi and driven by a 500-hp 1170-hp squirrel-cage motor.

At Longview, Tex., three single-stage booster pumps take oil from storage tanks and deliver it to the suction of the main pumps at about 50 psi. This suction pressure is sufficient for safe operation of the main pumps at their comparatively high specific speed (1330) without vaporization or cavitation. The booster pumps are rated 110,000 bbl. daily (3210 gpm) at 110-ft head, and are driven by 100-hp explosion-proof squirrel-cage motors.

Controlling and dispatching oil through the line is directed from a central office by teletype. If a pump is

Super-silvertops
are on the FUEL CONSERVATION FRONT

Fuel shortages are threatening our war effort. As a part of a fuel conservation program, savings must be made wherever possible by cutting down heat loss, and increasing the efficiency of steam-using equipment. Right out on the fuel conservation front are Anderson Super-Silvertop Steam Traps. Saving fuel on steam-using devices is nothing new for Super-Silvertops . . . For years they have demonstrated how heat output can be increased from 25% to 35%—and fuel saved—by using these traps in place of inefficient traps to free the unit of condensation and air. Send for a copy of the book entitled, "How To Choose a Steam Trap."

THE V. D. ANDERSON CO.
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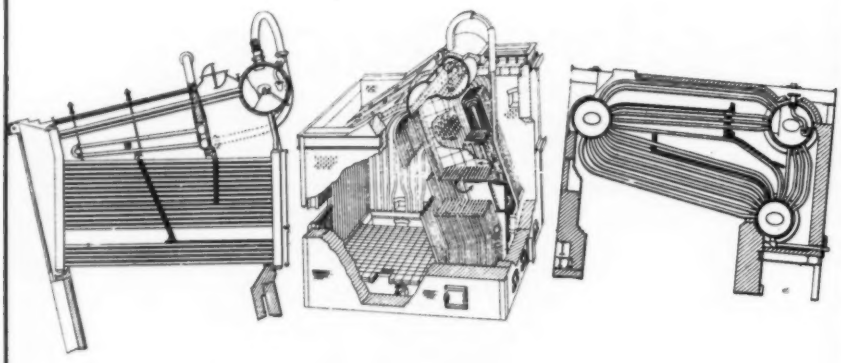

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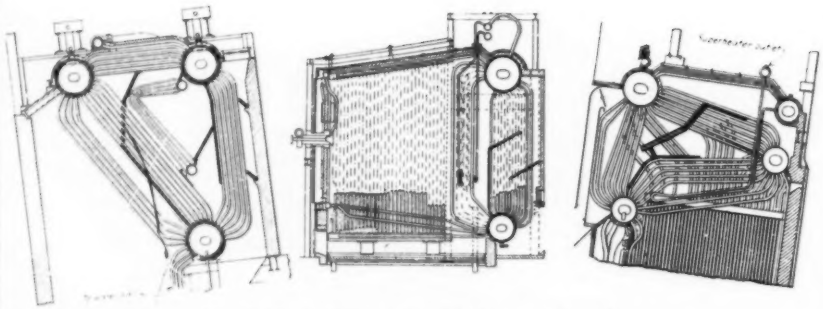

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shut down temporarily, capacity can be pinched down to suit. When half of the stations are operated, by dropping out every other one, the line handles about 60% of its rated capacity, or 180,000 bbl per day. Two pumps operating in each station deliver about 270,000 bbl per day.

Because of the project's size and cost and the great need for putting petroleum on the East Coast, not only for the Army and Navy but also for the vast civilian population, Big Inch is one of the war's outstanding achievements. Many war projects will probably be of little use after the emergency, but here is one facility, built under wartime conditions, that will function with lower operating costs and a lower investment of money and critical materials per unit handled than any other in its field. After the war, the line will compete successfully with tanker transportation.

Heat-Balance Short Cut

(*Continued from page* 81)

H_e = State-line end point, Btu per lb

H_t = Heat content at throttle conditions, Btu per lb

ME = "Mechanical" efficiency, so-called, which includes both mechanical and electrical losses and is equal to one minus the sum of the two losses divided by the net output plus the losses, that is,

$$1 - \frac{\text{Mechanical loss} + \text{electrical loss}}{\text{Output} + \text{mech. loss} + \text{elect. loss}}$$

EL = Exhaust loss, Btu per lb

AE = Available energy,—initial to exhaust conditions,—Btu per lb

The exhaust loss, EL, depends on several variables, among which are axial velocity of the steam leaving the last stage, the last stage bucket discharge angle, pitch-line velocity of the last stage, the exhaust hood configuration, flange area, etc. A plot of exhaust loss curves has been presented in a recent ASME paper‡ which indicates that the shapes of exhaust-loss curves are very similar for all of the larger machines built by the General Electric Co. when plotted against exhaust velocity.

The value, H_e, as found above, is significant and useful in that it determines, together with the inlet conditions, the location of the state-line, hence the heat content at any stage in the turbine. The amount of steam extracted is affected by these stage heat contents and, in turn, the heat rate is affected by

‡ "Relative Engine Efficiencies Realizable for Large Modern Steam-Turbine Generator Units", by G B Warren and P H Knowlton, *ASME Transactions*, Feb. 1941

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Save Metal in Wartime — Will Save You Money in Peacetime

Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the Coppus steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. More than 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

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Sales offices in Thomas Register; Products in Sweets

BLUE RIBBON PRODUCTS

DESIGNED FOR YOUR INDUSTRY...ENGINEERED FOR YOU

If a COPPUS "Horse Power" Steam Turbine can power your pump, blower, fan, stoker, dryer, mixer, etc. . . . then you'd waste money and metal buying an "Elephant Power" Turbine. COPPUS Blue Ribbon Turbines come in 6 frame sizes; matching size to job saves critical metal for war and money for yourself.

And the blue ribbon means workmanship that promises peak performance.

Make Good Piping Better

with

WELDOLETS • THREDOLETS

3 Types Meet Every Need

WeldOlets for butt welded branch connections.

ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type welded branch connections.

Save Weight

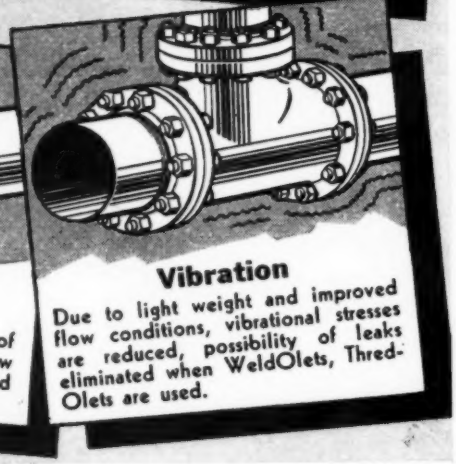
WeldOlets, ThredOlets keep the weight of any piping system to a minimum. Fewer flanged joints mean less possibility of leaks.

Gaskets, Bolts, Nuts

Maintenance eliminated when WeldOlets, ThredOlets are used—no need to change gaskets, tighten nuts and bolts.

Flow Improved

Funnel-shaped intake aperture of WeldOlets, ThredOlets improve flow conditions, reduces turbulence and friction.



Vibration

Due to light weight and improved flow conditions, vibrational stresses are reduced, possibility of leaks eliminated when WeldOlets, ThredOlets are used.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line—and always with ease and economy. They are equally well adapted to pre-fabricated or "on-the-job" assemblies. Stocked for all standard pipe sizes up to 12" in size-to-size and reducing sizes—and can be supplied on special order for pipe up to 24". Stock fittings are drop forged steel, but to meet special conditions will be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for your copy today.

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ARMY E NAVY

Star Awarded July 10, 1943

WELDOLETS • THREDOLETS

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Welded Outlets for Every Piping System

the amount of steam extracted. For use in this method of calculation the quantity t $(H_e - h_e)$ is used, which is either the heat rejected per pound (with zero exhaust loss) in the condenser, or, from another viewpoint, the heat given up by steam extracted for the first infinitesimal heater in a cycle having an infinite number of heaters (that is, t is the "terminal" value of $H-h$). The value of the quantity, $(H-h)$, for any other heater in the cycle is a function only of the initial steam conditions, for actual state lines, and the feedwater enthalpy leaving the heater.

Editor's note: Further details of turbine heat rate calculation by Mr Salisbury will appear in November Power

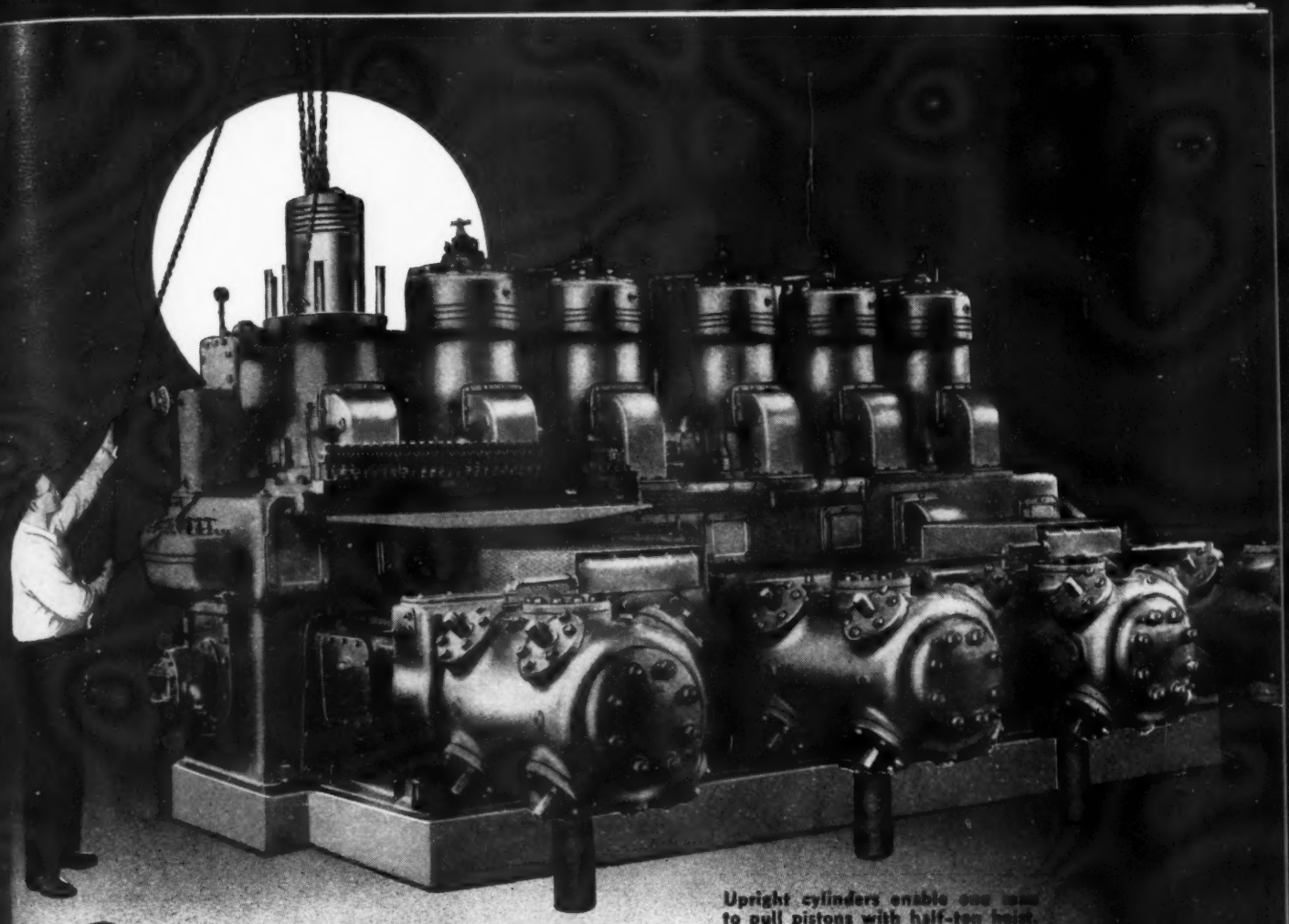
Meters Fluctuating Flow

(*Continued from page* 85)

rapid. Laboratory tests on integration accuracy showed the readings within ±1% regardless of instantaneous changes in circuit conductance.

For range of 25.7 to 63 in. of water maximum differential, the meter body, Fig. 2, follows almost all fluctuating flows satisfactorily. It has no moving elements except for the rise and fall of mercury within the resistance scale chamber. The resistance scale has 91 contact rods. At zero flow differential, mercury is not in contact with any of the rods and no current flows in the current circuit. At 10% of maximum meter capacity, mercury contacts the longest scale rod, and successive rods contact the rising mercury until the scale resistance is entirely shorted out at maximum flow. Mercury passages are large and short, and the quantity of mercury, which must be transferred from one chamber to the other upon a change in flow, is small.

When other differential ranges are required, a combination pneumatic-electric meter, Fig. 3 and 4, meets the requirements. Flow differential from the orifice plate is impressed across the pneumatic - transmitter differential-measuring diaphragm D, Fig. 4, sealed from the atmosphere on its upper side by a metallic bellows B. Flow differential measured by diaphragm D is transmitted to the weighbeam W pivoted on a ball-bearing fulcrum. In operation air pressure under reaction diaphragm R balances the force across differential diaphragm D. When the differential pressure changes, weighbeam movement changes the opening of bleeder valve V and the resulting change in



Upright cylinders enable one man to pull pistons with half-ton hoist.

Maintenance FAR LOWER with CLARK-2-CYCLE

USES LESS OIL—EASIER TO SERVICE

A basic advantage of the 2-cycle engine is far lower maintenance, due to 4 causes:

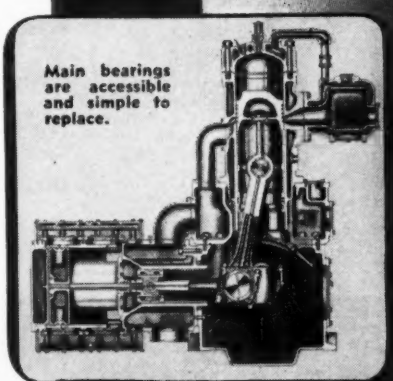
1. Greater simplicity of design. No complicated valve gear, only a simple fuel injection system operating during the cool part of the cycle. Fewer connecting rods and bearings.

2. Greater simplicity of operation. Power is obtained with half the number of piston strokes. Cylinder and piston wear are much lower.

3. Far lower oil consumption, as leakage past rings goes out exhaust ports, not to crankcase.

4. Minimum down time, due to ease of servicing upright cylinders, and accessibility.

We invite your investigation.



Main bearings are accessible and simple to replace.

CLARK BROS. CO., Inc., OLEAN, NEW YORK. Export Offices: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Tex.; Chicago, Ill. (122 S. Michigan); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5715 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1, London; Avda Roque Saenz Pena 832, Buenos Aires.

CLARK

Super-2-Cycle

AFFILIATED COMPANIES: Dresser Mfg. Co., Bradford, Pa.; Pacific Pump Works, Huntington Park, Calif.; Bryant Heater Co., Cleveland, O.

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Put R/M on the Job . . .

Harvest the fruits of uninterrupted service with sound packing. Eliminate weak spots in steam lines, oil lines, fuel lines, and air lines with R/M Packings. Ceaseless laboratory development over many years has made R/M Packings equal to the added strains of industry at war.

Your local R/M distributor can supply you with the proper R/M Packing material for every industrial use. Ask him for catalog or write us direct.

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pressure on diaphragm R rebalances weighbeam W. Thus, the pneumatic transmitter establishes an air-loading pressure directly proportional to the flow differential. Maximum displacement of diaphragm D causes a volume change of less than 0.25 cu in. and maximum linear travel of D is approximately 0.01 in., which makes the pneumatic transmitter inherently fast in operation.

Air-loading pressure from the transmitter is impressed on an electric meter body especially designed for this service to use a minimum quantity of mercury consistent with good accuracy of the electrical-resistance circuit, and with large mercury passages. The pneumatic transmitter can be supplied in ranges as low as 0 to 1 in. of water differential for 15 psi line pressure, or as high as 9 to 800 in. of water differential for 600 psi line pressure, the range depending on diaphragm and leverage combinations.

The complete meter equipment, Fig. 3, practically overcomes meter sluggishness and integrator inaccuracy of the ordinary orifice meter. In actual installations, piping connections between orifice plate and pneumatic transmitter, and between transmitter and meter body, are made as short and direct as possible.

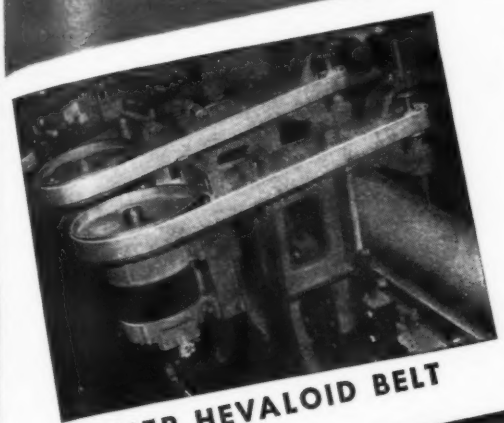
Output air-loading pressure from the transmitter, as it is measured at the meter body, instantaneously follows changes in flow differential. Reading instruments, integrator, and one or more indicators or recorders may be placed several thousand feet from the meter body, if required, without affecting the meter response.

Laboratory Tests

Laboratory tests of the complete meter have shown an over-all accuracy within $\pm 2\%$ for various flow cycles, including a cycle as short as 8 sec flow on and 8 sec flow off. Field installations have proved satisfactory, substantiating laboratory tests. While some installations were furnished with recorders, they were not practical, as explained previously.

The chart, Fig. 5, was taken from a meter on oxygen flows in a steel mill. Most oxygen flows are very erratic, and those of magnitudes sufficient to justify installation of flowmeters are to automatic cutting or scarfing machines. Oxygen flow to a scarfing machine may last less than 1 min with practically instantaneous cuton and cutoff. Previous to the actual scarfing, the small flow of preheat oxygen alone may be at a rate of 2 to 4% of the scarfing rate which may last about 10% of the total scarfing

A SPECIALIST DOES THE JOB RIGHT!



GILMER HEVALOID BELT

GILMER *specializes* in belts! As the oldest firm of rubber-fabric belt specialists, with over a third of a century of experience in building belts for machinery all over the world . . . Gilmer has developed a complete line of standard V-Belts and Endless and Non-endless Flat Belts. The largest assortment of V-moulds in the world is maintained . . . necessary for the production of a well rounded line. In addition, engineering and manufacturing facilities are maintained for highly specialized belts for use wherever standard belts are unsuited.

V-Belts for multiple and light duty drives.

Kable Kord Flat Endless Cord Belts, a contactor and power belt, two-belts-in-one.

Gilmer Hevaloid Endless Belts: Light weight and vibrationless for high speed precision work.

Flat Roll Belting for line shaft drives.

High Speed Belts **Special Endless Belts**

Round Endless Belts **Planer Belts**

and Belts for Textile and other specialized industries.

● Write for a FREE copy of Gilmer's Handy Belt Selector . . . a mine of information.

GILMER SPEEDAGE BELT

USE WHAT YOU LOSE

Gilmer BELTS

MORE POWER TO YOU

The Gilmer Engineering Staff specializes in power transmission problems. And the same ingenuity which is solving belt problems all over the country, also has planned an important FREE wartime service to Industry. It's the Gilmer National Power-Recovery Plan, approved by the WPB to save power in the following services: Steam, Gas, Water, Electricity, Mechanical Transmission, Boilers, Compressed Air, Refrigeration and Prime Movers. Write for your FREE copy today.

L. H. GILMER COMPANY, Tacony, Philadelphia 35, Pa.

The Oldest Firm of Rubber Fabric Belt Specialists

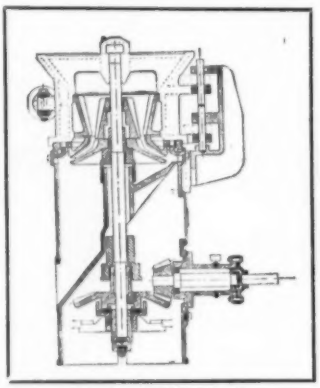
Why guess

at the coal you're using and lose money . . .

. . . when you can

KNOW YOUR B.T.U.'S

save and get maximum plant performance



Instant sampling is assured by the "STURTEVANT"

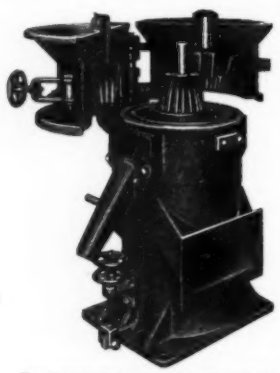
. . . by sampling coal automatically and accurately

THE STURTEVANT WAY

Hit-and-miss inaccurate results from hand sampling are "OUT" when you put the IMPROVED STURTEVANT AUTOMATIC COAL CRUSHER and SAMPLER to work. Not only is limited manpower (for hand sampling) replaced by machine power the "STURTEVANT WAY" but you are assured accurate representative samples that give you constant, true values of the coal you buy and burn.

Now is the time to eliminate guesswork—now when your sources of coal supply are such variable factors and when to "know your B.T.U.S." is so essential to the proper operation of your plant and its uninterrupted service. By eliminating guesswork as to your coal, the "STURTEVANT WAY" provides the means for adjusting your plant exactly to the coal as it is delivered to your bunkers. Now is the time to get the highest return from the dollars you spend for fuel, which today are probably your biggest single item of expense. Now is the time to provide your laboratory with coal samples that when analyzed will give you data from which maximum plant efficiency can be attained.

WITH THE "STURTEVANT", 3" coal samples are crushed to 8 mesh or finer at the rate of 1 ton per hour. Truly representative 5, 10 or 15% samples are taken ready for the laboratory.



Representative samples of coal are obtained by the "STURTEVANT" mechanically in a fraction of the time required for inaccurate hand sampling.

WRITE AT ONCE FOR

a copy of "HOW TO SAMPLE COAL AUTOMATICALLY." It contains important information on how to get the most out of your coal.

What users say

"The crusher gives us a more representative sample of a carload than we could hope for with hand sampling and with less expense."

"The difficulty of getting a laborer to conscientiously follow out the various steps eight or ten hours a day, every day of the week and the "human element" of inaccuracies are all elimidated."

Sturtevant Mill Co.

103 Clayton St., Dorchester, Boston, Mass.

time. For safety, oxygen should not be admitted to the electric meter body, nor should it be sealed off by oil. Pneumatic transmitter, however, may be constructed of materials safe for such service and oxygen admitted directly to the differential chamber and flows, as in Fig. 5, integrated with a combination pneumatic-electric meter.

When measuring ammonia, particularly anhydrous ammonia at high pressures, do not permit it to come in contact with mercury. No satisfactory sealing fluid has been found that does not absorb ammonia to some extent. The combination pneumatic-electric meter has proved a solution on this application.

Fuel oil flow to boilers and furnaces

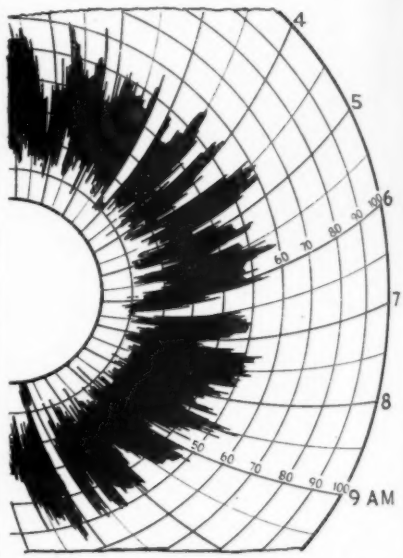
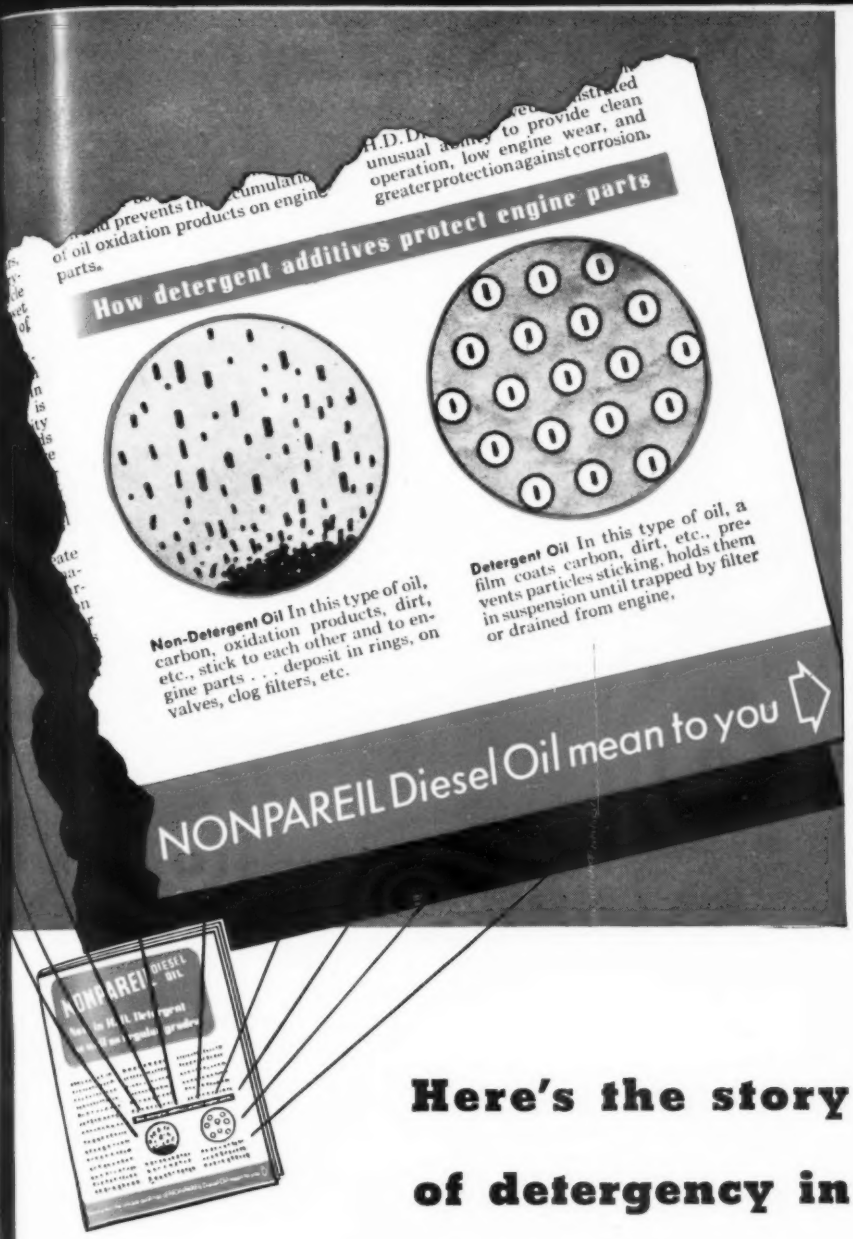


Fig. 5—This chart, taken from a meter-recording oxygen flow in a steel mill, is an example of rapidly fluctuating flow

is frequently of a highly varying nature, and the problem of measuring it is further complicated by the difficulty of keeping the oil in the lead lines from congealing. Seal pots, whereby a different liquid, which does not congeal at atmospheric temperature, is kept in the meter chambers and lead lines, are frequently used, but are always a source of annoyance and trouble. These difficulties may be obviated, however, by mounting the pneumatic transmitter directly on the flow line, with the lead lines and diaphragm chamber covered by the insulation. The cast-iron saddle on which the transmitter is mounted, transmits heat from the flow line to the meter chamber and keeps the oil in the diaphragm chamber sufficiently warm for satisfactory operation. It is necessary, of course, that flow temperature of the oil be high enough and constant, to avoid errors due to viscosity.


How detergent additives protect engine parts
Non-Detergent Oil In this type of oil, carbon, oxidation products, dirt, etc., stick to each other and to engine parts . . . deposit in rings, on valves, clog filters, etc.
Detergent Oil In this type of oil, a film coats carbon, dirt, etc., prevents particles sticking, holds them in suspension until trapped by filter or drained from engine.
NONPAREIL Diesel Oil mean to you

Here's the story of detergency in new Nonpareil H. D. Diesel Oil

...detergency, plus high oxidation stability, bringing new engine cleanness, notable wear reduction, and longer oil life

● If you're having trouble with ring-sticking, piston scuffing, excessive carbon, sludge, or gum deposits, you'll want to read this bulletin, "Nonpareil Diesel Oil—now in Detergent as well as Regular Grades." It gives laboratory and field-tested facts which show that the troubles mentioned above can be practically eliminated by the use of new Nonpareil H. D. Diesel Oil.

This detergent-type addition to our Nonpareil line brings a new degree of engine cleanness. It not only *keeps* engines cleaner, but in many cases will remove deposits left by other oils. The detergency (see diagram) comes from an additive which is both a detergent and an oxidation inhibitor.

Wherever Nonpareil H. D. Diesel Oil has been used, the results have been outstanding. The cleanness and improved engine operation have been quickly noticed.

Where to use detergent-type oils. Our regular line of Nonpareil Diesel Oils, over a long period of years, has established a fine record for engine cleanness and low wear. In fact, many engines give clean operation with these regular-type oils. But where dirty operation cannot be corrected by mechanical adjustment, the use of the new detergent-type Nonpareil H. D. is recommended.

A Standard Lubrication Engineer will gladly advise you which type and grade will give you the best possible results in your Diesels. Why not make a test in some unit in which conditions are severe? Phone or write for the Engineer nearest you.

Send for Bulletin. Get the full facts about this great new oil. See how its characteristics fit it to handle difficult service conditions. Note its applications to various makes and models of Diesels, etc. Send now for your copy of our Nonpareil Diesel Oil Bulletin. Write or call any Standard Oil Company (Indiana) office, or 910 S. Michigan Ave., Chicago 5, Ill. In Nebraska, address Standard Oil Company of Nebraska at Omaha 2.

Oil is ammunition... Use it wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

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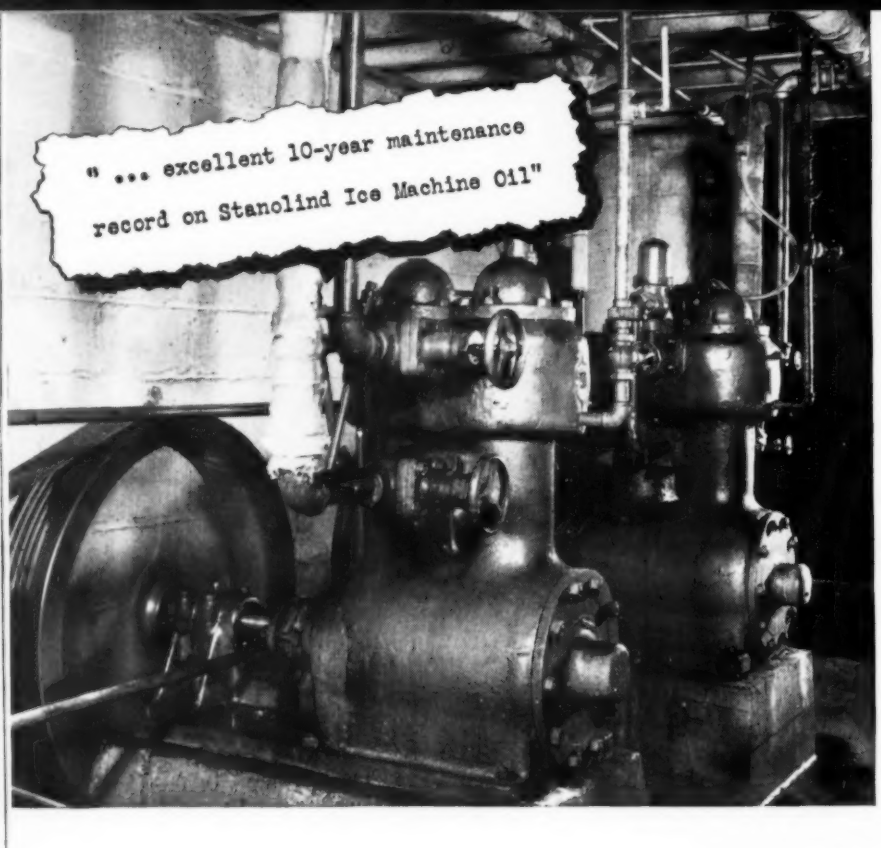


These two York ammonia compressors in a Minnesota dairy, and a similar installation in a large ice plant, have made excellent maintenance records in 10 years' operation on Stanolind Ice Machine Oil.

How Minnesota plant guards compressors against "absenteeism"

• IN THESE DAYS of all-out production, there must be no costly shutdowns of refrigerating machinery for repairs ... there must be fewer replacements of bearings, pistons, and other hard-to-get parts. Power and oil consumption must be held to a minimum. The following letter shows how a Minnesota ice plant is saving on all three points.

"We have been using Stanolind Ice Machine Oil in our two York Ice Machines for the past ten years. And in that time, we have had absolutely no bearing trouble ... no bother with oil congealing ... oil consumption has never been excessive."

For you, as for hundreds of other users of refrigerating equipment throughout the Middle West, Stanolind Ice Machine Oil can also give protection against many needless shutdowns —can aid in your victory effort to produce more with less power, labor, and maintenance. Stanolind has what it takes to hang on a long time: high stability; low pour point; marked resistance to formation of harmful acids and sludge.

Two heads are better than one in licking your lubrication problems. What new equipment is available ... where to get replacement parts ... how to get and train new personnel? The list of new operating problems in every industry is long and varied. But don't overlook the importance of good lubrication in preventing breakdowns before they happen. A Standard Lubrication Engineer near your plant is ready to work with you on your troublesome lubrication worries. Because of his many contacts with other plants similar to yours, he may already have the answer to many of your questions about better machine maintenance, reduced power consumption, etc. Call any Standard Oil Company (Indiana) office, or write 910 S. Michigan Ave., Chicago 5, Ill., for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Oil is ammunition ... Use it wisely

Practical tips on refrigeration compressor lubrication

Avoid excess oil in compressor cylinder lubrication. Much less oil is needed than for steam engine cylinders of equal size. Oil is not washed away, as it is in steam engines, nor burned, as it is in internal combustion engines. It remains in the cylinder a long time, and for that reason large quantities of oil are not needed.

In splash systems the oil level should not be carried too high, as the churning will throw too much oil into the system and make removal by the separator difficult.

Oil separators should be located near the condenser, and as far as possible from the compressor, to allow precipitation of any oil mixed with the gas.

Oil from traps should not be used again without purification, as many contaminants are collected in the traps along with the oil.

Lubricant recommendations depend in a great measure upon the type of refrigerant used, method of lubricating, and individual characteristics of design of your installation. A Standard Lubrication Engineer will gladly study your requirements and recommend the most economical oil for your needs.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Scovill Tube News

SCOVILL MANUFACTURING COMPANY, Waterbury, Conn.

Factors Affecting War-Time Efficiency of Condenser and Heat Exchanger Tubes

The widespread use of copper and copper alloys in heat exchanging equipment is due in some measure to the many favorable physical properties of these materials, i.e., their ductility, toughness, strength, high thermal conductivity, etc., over a wide range of temperatures and pressures. The excellent corrosion-resistance of the copper alloys under most operating conditions, however, is of major importance in this application. The ability of copper and its alloys to withstand the corrosive action of such media as fresh and salt waters, sewage, hydrogen sulphide, acids, alkalis, etc., is of a high order and has established their value in tube form in contact with corrosive media. They have proved their dependability and economy under such conditions as well as under wide fluctuations of temperature, pressure and velocity of the circulating media.

Serious corrosion of condenser and heat exchanger tube does occur, however, particularly when corrosive conditions are admittedly very severe and such corrosion may result in considerable expense, costly delays and shut-down of equipment. In many cases, no improvement in tube life can be expected under existing conditions; in other cases, however, it has been possible to reduce or retard corrosion materially and obtain improved tube performance either by slight changes in operating conditions, by attention to certain operating details or by a change from one tube alloy to another which is more corrosion-resistant to the particular service conditions. For this reason, an appreciation of the factors which contribute to corrosion of tube materials is often of value to a better understanding of corrosion problems; this knowledge, in turn may be used to advantage in combatting such problems and in improving tube life. The subject is considered of sufficient importance to tube users to warrant discussion of the more important matters pertaining to corrosion problems.

"Service in Manuals" Designed for Scovill Customers Now Freely Avajlable to All War-time Tube Users

The "service in manuals" begun by Scovill years ago to assist customers in choice of alloys to fit specific corrosion and installation conditions, is now proving useful to many war-time firms faced with increasing need to conserve scarce tube metal. You may find in Scovill's "Condenser Tube Booklet" just the information you need — diagrams, formulae, lists of alloys — to make your condenser tubes serve you better and longer. Write Scovill Manufacturing Company, 13 Mill Street, Waterbury, Conn.

Factors Affecting Tube Life

The service life of condenser and heat exchanger tubes is governed by the following major influences:

1. the composition of the alloy
2. the workmanship and quality of the tubes
3. the conditions of service of the tubes

The most satisfactory tube service and tube performance in a heat exchanger unit is obtained only after a careful consideration of these factors.

The Composition of the Alloy

The nonferrous alloys for heat exchanger service may be grouped into three broad classifications, as follows:

(a) Copper, Phosphorized Copper and Arsenical Copper

(b) Brasses or Copper Zinc alloys, usually containing small percentages of other metals such as Tin, Aluminum, Nickel, Iron, Lead, etc.

(c) Copper Nickel alloys, containing Copper, Nickel and, in some cases, minor amounts of other elements such as Tin, Iron, Manganese, Zinc, etc.

Scovill offers a complete range of tube alloys.

Muntz
Admiralty
Phosphorized Admiralty
Red Brass
Deoxidized Copper
Arsenical Copper
Aluminum Brass
70-30 Copper-Nickel
80-20 Copper-Nickel

Each of these has special characteristics which make it particularly suitable for use under certain conditions.

Scovill can place at your disposal the advice and consultation of men with years of experience in practical tube problems.

A Scovill tube material or method of installation may be of aid to you in obtaining longer tube life.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

HERE'S THE *Short cut*

FYR-FEEDER
MULTIPLE SPREADER STOKERS
BURN COAL LIKE OIL!

TO

Higher Steam Capacity

NEED MORE STEAM? The quick and economical solution is to install multiple FYR-FEEDER stokers in present boilers to get higher capacity . . . higher coal burning efficiency . . . and lower fuel costs which assure a high return on the investment. Here are the facts on the multiple FYR-FEEDER:

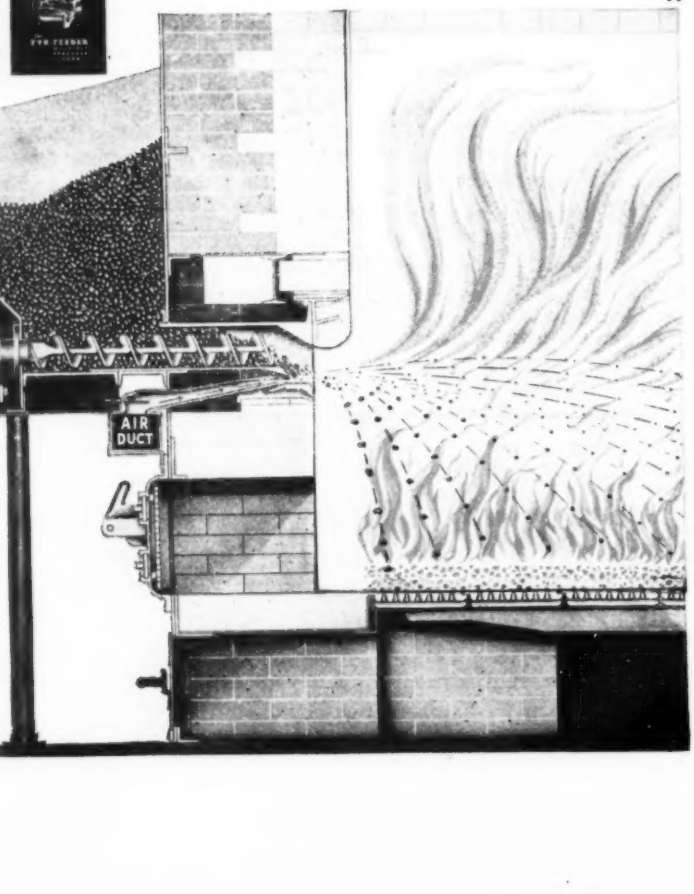
Burn Any Coal, screenings or sweepings, you have available locally; any bituminous coal, any melting point of ash, free-burning or coking coals.

FYR-FEEDER Burns Coal Like Oil. Burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed, with greater active coal burning area. Thin fuel bed, no clinkers. Fires can be cleaned in two minutes.

Quick Delivery. Priorities are being granted to plants requiring additional steam generating capacity; and we can make Quick Delivery. Multiple FYR-FEEDER stokers can be installed in large or small boilers with minimum loss of production time.

AMERICAN COAL BURNER COMPANY

WRITE FOR CATALOG *describing features, operation and typical installations; or for an engineer to make a survey of your plant.* **32-18 E. Erie St., Chicago 11, Illinois**



Radiant Heating

(*Continued from page 87*)

water temperature, Fig. 2 shows that 1 in. pipe 12 in. on centers would supply 42 Btu/sq ft, and 1¼ in. pipe 18 in. on centers would supply 35.5 Btu/sq ft. In this case, 1-in. pipe was selected as this size was to be most generally used and as a slight adjustment of mean water temperature would permit securing the required heat input.

Total input required to be supplied to this zone:

37.7 Btu/sq ft × 5520 = 208,000 Btu/hr.

Amount of water to be circulated:

$$\frac{208{,}000 \text{ Btu}}{20 \text{ F} \times 60 \text{ min} \times 8 \text{ lb/gal.}} = 21.7 \text{ gpm}$$

Calculations for each separate room were made in a similar manner. Where small offices at exterior walls required an excessive floor temperature if all heating were to be done by the floor panel, a wall panel supplemented it and reduced the floor temperature to below 85 F maximum. Fig. 5 shows typical wall-panel construction.

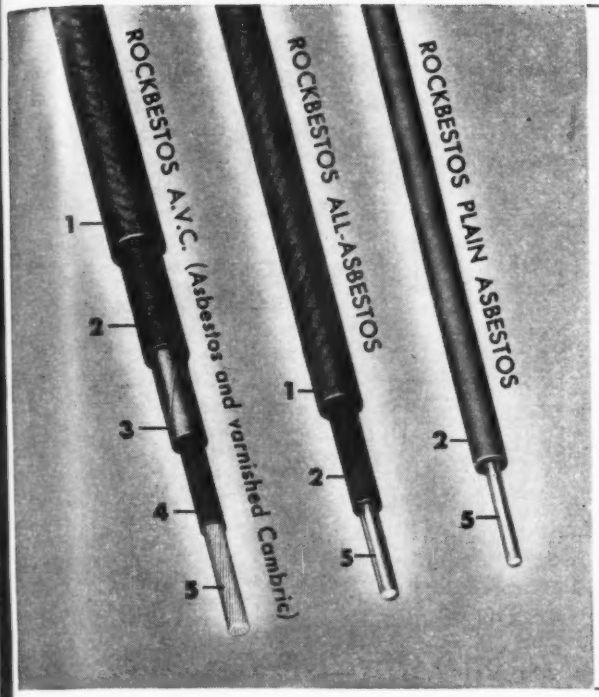
Zoning Arrangement

As calculated above, the east cafeteria has a designed floor temperature of 83 F, with 1-in. pipes spaced generally 12 in. on centers. The 5200 linear ft of pipe in this area is divided into four circuits. It was attempted in each of the four zones to design the circuits so that a rational balance between the small quantities of water handled and the pumping head of the pumps would be obtained. With approximately 22 gpm in this area, a 1½-hp motor was required for 68 ft head. The other three zones have pumps with 1-hp motor handling 14 to 20 gpm at 62 to 65 ft head.

Kitchen zone includes a number of rooms such as toilets, locker room, entrance and office. Main kitchen area has a designed floor-slab temperature of 77 F with 1-in. pipes 24 in. on centers. Toilet rooms and vestibule have designed floor temperatures of 90 F with 1¼-in. pipe 12 in. on centers. This zone is divided into three pipe circuits.

The west cafeteria with two exposed walls has a designed floor-slab temperature of 80 F with approximately 3600 linear ft of 1-in. pipe, 18 in. on centers. Three pipe circuits are used.

Most difficult problem was the personnel-examination area as it was sub-



3 GETS YOU 122

122 wires, cables and cords, stemming from the three basic designs illustrated, have been developed by Rockbestos to give trouble-free performance under severe operating conditions in steel mills, power plants, chemical industries, etc. Send for catalog to see the rest.

Rockbestos Permanent Insulation Insures Long-Lived Performance

1. A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
2. Felted asbestos insulation impregnated with heat-, flame-, and moisture-resisting compounds will not dry out, become hard and brittle, or burn. Also serves as a heat-barrier against high ambient temperatures.
3. Lubricated varnished cambric for high-dielectric strength and added moisture resistance, protected from heat, flame, and oxidation by felted asbestos walls.
4. Felted asbestos insulation that withstands conductor-heating overloads and won't burn even when exposed to copper-melting arcs.
5. The conductor is perfectly centered in helically applied insulation and will always remain so.

600 VOLT A.V.C. SWITCHBOARD WIRE—TABLE B

(Underwriters' Type AVB)

Sizes No. 18 to 4/0 A. W. G. with varnished cambric and felted asbestos insulation and gray, black, white or colored fireproof cotton braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is absolutely fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A. V. C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.

INDUSTRIAL HEATING CABLE—TABLE LH

No. 19 A. W. G. nickel-chromium wire insulated with .040" of felted asbestos and covered with 4/64" waterproof lead sheath.

This pliable cable distributes a mild heat evenly over a large area. Prevents freezing of water pipes, wet pipe sprinkler systems, etc. Keeps conveyor pipes for fuel oil, soap, varnish, ink, chocolate, etc., at temperatures that insure steady flow.

ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of A. V. C. Motor Lead Cable will complete the failure-proofing.

ALL-ASBESTOS FLEXIBLE CORD—TABLE CA

Sizes No. 10 to 18 A. W. G. with two or three conductors insulated with felted asbestos, covered with asbestos braid. Also in A. V. C. (asbestos and varnished cambric) constructions.

This heat-resisting flexible cord is ideal for high-wattage lighting units, floodlights, blueprint machines, apparatus, etc., which require a heavy duty, enduring cord. For moisture-resistant construction specify the A. V. C. type. Labeled cord with polarized conductors if desired.

600 VOLT A.V.C. BOILER ROOM WIRE—TABLE C

(Underwriters' Type AVA)

Sizes No. 18 to 4/0 A. W. G. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A. V. C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.

THERMOSTAT CONTROL WIRE—TABLE TC

Sizes No. 14, 16 and 18 A. W. G. in two to six conductors with 12½, 25 or 31 mil wall of felted asbestos insulation and cadmium plated steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal and temperature control systems. Its lifetime insulation and rugged steel armor will give you trouble-proof circuits.

600 VOLT ALL-ASBESTOS RHEOSTAT CABLE—TABLE R

(Underwriters' Type AI)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.

600 VOLT A.V.C. MOTOR LEAD CABLE—TABLE L

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric, heat-sealed varnished cambric insert, covered with heavy asbestos braid.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

600 VOLT A.V.C. CONTROL CABLE

In one to 19 conductors. Standard stranding A. W. G. No. 14—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

600 VOLT A.V.C. POWER CABLE—TABLE E

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid. Other constructions for service voltages to 8000.

Recommended for power circuits and hot spot wiring in or around boiler rooms, steam tunnels, soaking pits, tenter frames, glass plants, etc. The asbestos and heat-sealed varnished cambric construction has ample moisture resistance and withstands high temperatures.

Rockbestos Products Corporation, 915 Nicoll Street, New Haven 4, Conn.

WON'T bake brittle, bloom, burn or rot—
RESISTS heat, moisture, oil, grease and fumes

ROCKBESTOS

The Wire with Permanent Insulation

Here's **POWER** to Clean Tubes **FASTER** with Less Labor

A single operator can now clean tubes by himself by using a Roto Tube Cleaner equipped with an air valve. This not only releases a helper for other work around the plant, but actually enables the operator to clean tubes more efficiently. By controlling the entire operation of the cleaner, the operator doesn't have to waste time signalling a remote helper to turn air off and on between every tube cleaned. This exclusive Roto time- and labor-saving feature, plus the well-known power and cleaning efficiency of Roto Tube Cleaners, help solve many pressing problems during the present emergency. Write us today.

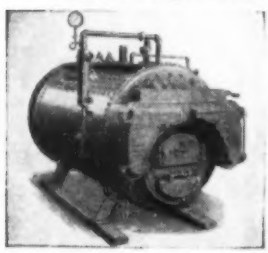
The ROTO Company

145 Sussex Avenue, Newark, N. J.

ROTO Tube Cleaners

KEWANEE

SCOTTIE JUNIOR BOILER



5 sizes... 9 to 30 hp. . . . conveniently compact, yet easily accessible. Low in cost...economical to operate.

KEWANEE BOILER CORPORATION

KEWANEE, ILLINOIS

Division of American Radiator and "Standard" Sanitary Corporation

For 6" scale with pipe diameter markings, write Dept. 99K—X

divided into many different-sized rooms. Interview rooms and offices had 8-ft partitions separating them from the main office space. Ratio of floor area to heat loss made it impossible to install sufficient piping in the floor for adequate heat without extremely high floor temperatures. Partitions being open at the top, part of the heat loss was allocated to the main office area and additional pipe was installed there to take care of the extra loss. In addition, four separate wall coils of 1¼-in. pipe, 12 in. on centers, were installed. Other than the above, all pipes are in the floor slab. The main personnel area has a designed floor-slab temperature of 77 F with 1-in. pipes 24 in. on centers. Interview rooms and offices have designed slab temperatures of 85 F with 1-in. pipes generally 12 in. on centers. Toilet rooms and main entrance have designed slab temperatures of 96 F with 1¼-in. and 1½-in. pipe, 12 in. on centers. Because of the cut-up area of the surface, this zone was divided into six circuits.

To save installing a large number of lockshield balancing valves which, by the nature of the system, would be difficult of access, great care was taken to design each circuit with equal pressure drop. This care was justified by results of initial tests. Most of the 16 circuits were sufficiently in balance so that it was necessary to install valves in only a few circuits.

Preliminary Operation

Operation has not been of sufficient duration to determine whether a less liberal allowance would have compensated for the downward heat loss into the ground. Preliminary tests indicate that possibly a smaller allowance would have been adequate as inside temperatures have been comfortable in severe weather with slightly lower water temperatures than calculated.

Relative assembly of circulation and heating equipment serving the heating installation is diagrammed as shown in Fig. 3.

Hot water converter, circulating pumps and controls are located in an equipment room in an adjacent manufacturing building because of lack of space in the personnel building. The four hot-water supplies and returns run underground in a trench and thence underfloor to the various zones. Throughout care was taken to allow for expansion and contraction in the connections from the underfloor mains to the piping in the slabs. Steam is supplied to the converter at 10 psi. A self-contained temperature regulating valve

AIR is LIFE
to a stratosphere pilot...
BUT DEATH
TO UNSTABLE
TURBINE OILS!
NO MATTER what kind of turbine you operate, air bubbles are going to get into the oil. As a result, a constant battle is waged between oil and air. And once oxidation gets the upper hand over an unstable oil it breaks down rapidly.
However, this is not true of Shell Turbo Oil. For this history-making oil has the ability to resist oxidation to a degree never before thought possible in turbine oil operation.
But in today's high speed turbines even *oxidation stability* is not enough. A turbine oil must also be able to *prevent rust.* Shell Turbo Oil has both of these requirements necessary to economical, trouble-free turbine operation. And it's because of these superior qualities that more and more operators are draining, flushing and refilling their turbines with Shell Turbo Oil.
For full details call in the Shell man. Or, write Shell Oil Company, Inc., Dept. "F," 50 W. 50th Street, New York 20, N. Y. or 100 Bush Street, San Francisco 6, Calif.
SHELL
SHELL TURBO OIL
Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil

THE LARGER THE STEAM PLANT YOU ARE OPERATING, THE GREATER THE SIGNIFICANCE OF THIS EXAMPLE OF SPENDING A LITTLE TO SAVE A LOT

"Our plant," explains the Superintendent. "uses 180° water to sterilize bottles. Formerly we had to maintain a steam pressure of 10 lbs. to heat the water. Now, *after modernizing with Hoffman 50 Series Traps*, steam at 4 lbs. pressure does the trick. Translated into terms of fuel, the drop in steam pressure has resulted in a saving of over 20%."

We quote this case, not because it is an outstanding example, but because it follows the *usual pattern* when antiquated steam traps are replaced with modern Hoffman units.

There never was a time when elimination of waste from steam plant operation was more vital. Fuel shortages and the need for ever-growing production make full efficiency imperative. Perhaps your own fuel costs have been creeping up . . . with every dollar added to operating expense a direct deduction from profit. Therefore, modernization of your steam plant with Hoffman Traps cannot be considered an expense, but an investment paying *measurable* dividends in fuel saved.

Hoffman engineers are always available for consultation. Your request for a heating survey will be promptly honored—without obligation.

HOFFMAN 50 SERIES TRAP FOR HEAVY DUTY
Easy Inspection and Servicing

Periodic inspection of heating equipment is a maintenance "must" today. In the Hoffman 50 Series Trap all working parts are mounted on the cover — easily removed without breaking a single pipe connection. This trap can be opened up, examined and put back into service with a minimum of time and effort.

Write for latest Catalog of Hoffman Steam Traps

HOFFMAN CONTROLLED HEATING

STEAM HOT WATER

HOFFMAN SPECIALTY CO., 1001 YORK ST., DEPT. P-10, INDIANAPOLIS 7, INDIANA

Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.

maintains a constant water temperature in the converter.

A 125-gal. closed expansion tank with water-fill line, and combination pressure-reducing and relief valve provides for expansion. Four hot-water circulating pumps operating continuously handle the circulating water.

Zone Control

Each of the four zones is controlled by a 3-way mixing valve. An adjustable immersion thermostat with remote control located on a main panel board is installed to operate each 3-way valve. The basic water temperature for these thermostats is regulated by an outdoor pilot thermostat. The remote-control adjustable feature of these thermostats permits increase or decrease of basic water temperature to meet possible variable demands in the different zones. As a case in point, the personnel area has an asphalt tile floor, while the rest of the areas have monolithic floors. Asphalt tile floors require 10 to 15 deg. higher water temperature than monolithic floors. Moreover, during busy hours the kitchen requires lower water temperatures than the other zones. Immersion thermostats can take care of these variations through manual operation from the panel board.

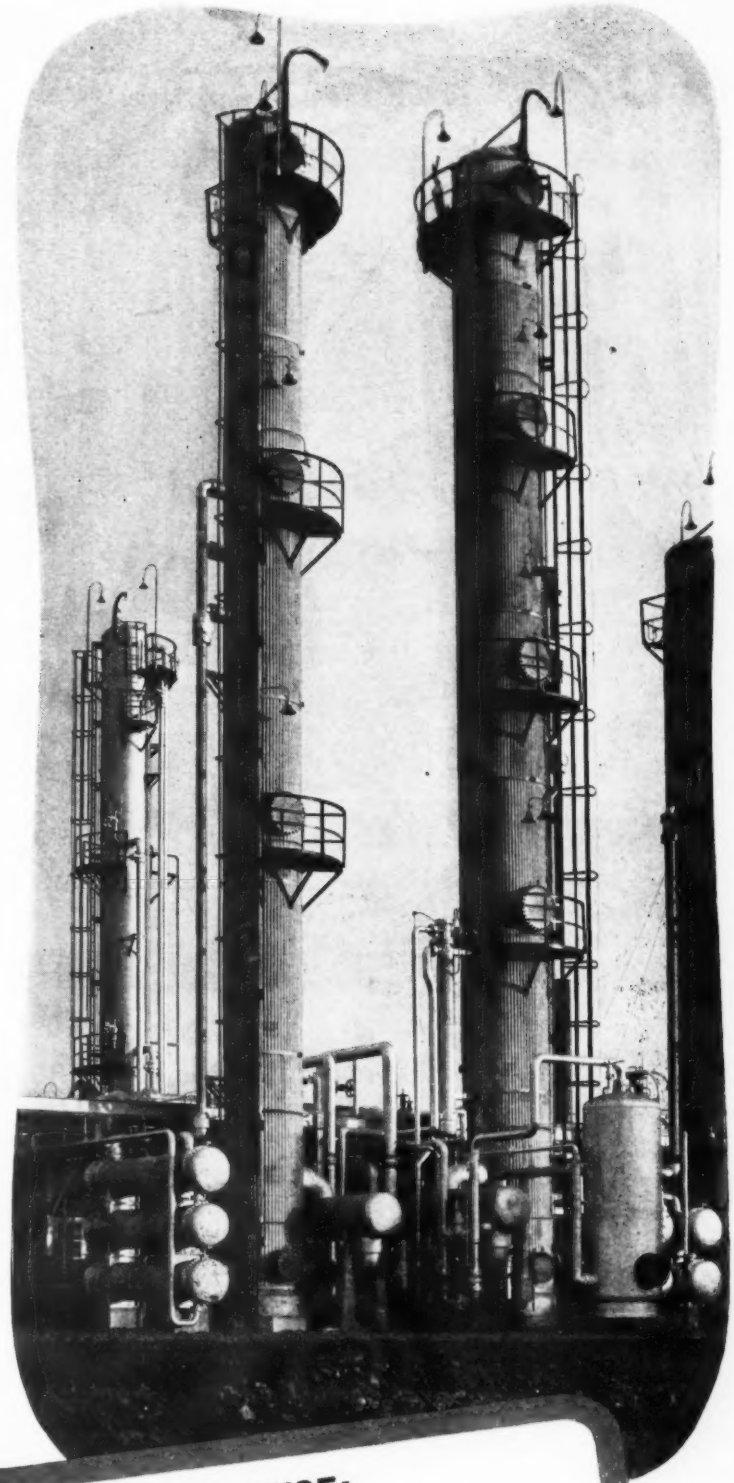
Piping Installation

All the piping is genuine, standard weight, wrought iron. It was bent cold at the job and assembled in sections above the spot in which it was to be located. After welding, the coils were laid in position and final connections were welded in place. A 500-psi hydrostatic test was made for each circuit. Length of test period was 12 to 24 hr.

The photograph of a portion of the installation, Fig. 4, before pouring the floor slab gives a vivid idea of the general piping arrangement of this type of heating system.

Before the concrete slab was poured the pipes were laid approximately level and 2 in. above the finished grade to the center of the pipe. This left approximately 4½ in. of concrete above the greater portion of the piping. When the slab was ready for pouring, a temporary warm water connection was made to the pumps and water at 100 F was circulated through all pipes while the concrete was poured, and until it had thoroughly set. This allowed piping and concrete to attain an approximate average point of expansion. The rather unusual scheme seems to have been fully justified because during the first two operating months no cracks have been observed on the finished surface of the concrete floor slab.

REVERE
ADMIRALTY CONDENSER TUBES
GIVE LONGER LIFE



All Revere Admiralty Condenser Tubes are of the arsenical type.

Why?

Because Revere has found, through laboratory tests and field experience, that even small amounts of arsenic are most effective in suppressing "dezincification".

Hence, all Revere Admiralty Condenser Tubes are of the arsenical type. To specify "Revere" is to make certain of prolonging the service life of tubes even under the toughest refinery operations. This is a most important consideration in these days.

Oil products are the life blood of our war effort and any means to hasten production helps hasten the day of Victory.

Revere Condenser Tubes and Heat Exchanger Tubes are also available in a number of other alloys, with a wide range of characteristics with which to meet the exacting and exigent requirements of the petroleum industry.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N.Y.

BUY WAR BONDS *TODAY*
to Escape Axis Bondage *TOMORROW*

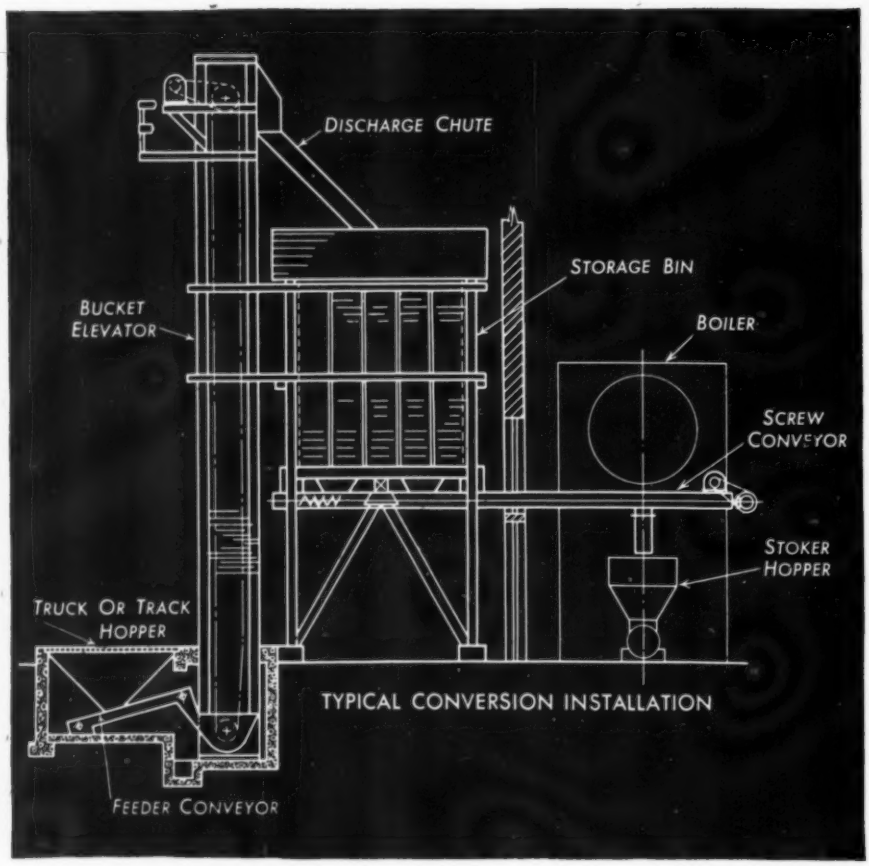
REVERE CHOSE ARSENIC BECAUSE:

1. Its effectiveness has long been proved by British practice.
2. Smaller amounts (generally .02%) proved effective.
3. The physical and working properties of tubes were least affected.
4. No record of failure due to "dezincification" has been recorded with Revere Arsenical Admiralty Tubes.
5. No case of intercrystalline corrosion has ever been noted in commercial installations of Revere Admiralty Tubes.

SENT FREE ON REQUEST:

A reprint of a paper by R. A. Wilkins, Director of Revere Research - "Corrosion of Copper and Copper-base Tubing in Oil Refinery Heat-Transfer Equipment"—sent on request. Address our Executive Offices. It will be sent without obligation.

NOT MUCH TIME LEFT
FOR CONVERSION TO COAL



TYPICAL CONVERSION INSTALLATION

Every indication points to continued shortages of fuel oil supplies for industrial plants. You'll feel safer with coal. The quick, efficient, economical way to convert your plant from oil to coal is to let Gifford-Wood do it for you. Hundreds of G-W coal and ash handling installations are helping to keep up industry's steam requirements. They'll serve for many a year after the war is over. Let G-W lay on your desk a complete plan and proposal.

For a quick appraisal of Gifford-Wood equipment write for Catalog P-200—mostly pictures, drawings, tables and engineering data. Free on request. Please use your business stationery.

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Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes
Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers
Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries 3685

Diesel Fundamentals

(*Continued from page 91*)

First is by poppet valves in the head, second by opposed-piston design, and third by *sleeve* or *slide valves*.

Sleeve-valve engines had a successful career in automobiles. The widely used Knight engine had two reciprocating sleeves which covered and uncovered inlet and exhaust ports in the cylinder wall. Absence of poppet valves made a quiet engine. But the manufacturing cost was rather high and also the lubricating-oil consumption.

If the engine operates on the 2-stroke cycle a simple reciprocating single sleeve can be used for charging and scavenging. One row of ports is at one end of the cylinder for inlet and another row at the opposite end for exhaust. The sleeve mounted between the piston and the cylinder also carries two rows of ports and receives its motion from the crankshaft through an eccentric or crank mechanism. Port opening and closing are controlled by the combined motion of piston and sleeve and in this manner good scavenging can be effected.

Sleeve-Valve Advantages

Advantage of the 2-stroke-cycle sleeve-valve engine lies in the absence of poppet valves, which permits use of simple symmetrical cylinder heads. Cylinders are short and do not require double crankshaft or long outside connecting rods as do opposed-piston engines. Nevertheless, its uniflow scavenging with rotary swirl permits high power output. Its disadvantage is the difficulty of cooling and lubrication because of the sleeve. Sleeve-valve diesel engines are now being developed for marine and aircraft propulsion. A 20-cyl sleeve-valve aircraft engine in a rather advanced stage of development is to give 2000 hp on one shaft and to weigh 1.0 lb per hp.

Instead of increasing the number of fillings of the cylinder per minute, it is also possible to increase the amount of air crammed into the cylinder every time. If the piston aspirates air into the cylinder, amount of air charge is limited. It can be increased slightly by increasing valve area and valve lift and by other means that improve the volumetric efficiency, but the charge can never exceed displacement volume. The volumetric efficiency is 1, if air charge equals the amount of free air corresponding to piston displacement. Volumetric efficiency of a naturally aspirated

Before
After
THREE 3-POLE CIRCUITS AND OBSOLETE OPEN TYPE MAIN SWITCH
TWELVE 3-POLE CIRCUITS AND PROVISION FOR TEN ADDITIONAL . . . SAME BOX, SAME CONDUIT

Here is the easy, economical way to provide for increased power demands

• Increased production has brought the demand for more power distribution in scores of plants. There are countless fusible panels similar to the one shown at the left above—inadequate and subject to excessive heating.

Notice how easy it is to convert to a compact, dead front circuit breaker panel. Notice, too, that by utilizing thin wall wire, additional circuits have been provided, using existing box and conduit.

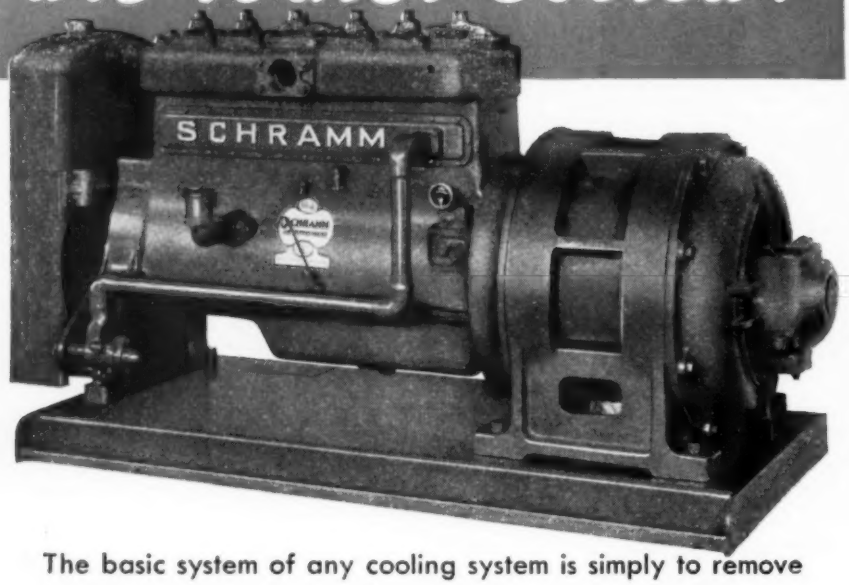
Your nearest Square D Field Engineer will be glad to work with you in determining your exact requirements for speedy, economical conversion.

ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

Why SCHRAMM COMPRESSORS are Water Cooled!



The basic system of any cooling system is simply to remove heat of piston travel and reciprocating parts from the surrounding metal as quickly as possible by the cooling medium. Heat travels from metal to water 200 times faster than from metal to air. By using water to carry heat away and by providing water jackets which completely surround compressor cylinders and heads, SCHRAMM achieves the following outstanding advantages:

... assured uniformity in cooling.

... elimination of unequal expansion and contraction which might cause distortion.

... absolute control of operating temperatures to the desired degree.

... longer life to compressor parts.

... higher efficiency of compressive cycle.

... higher compressor capacity at lower power cost.

... greater capacity in smaller overall space requirements.

... ability to provide compressed air efficiently under any and all temperature conditions.

... ability to provide compressed "air where it's needed," regardless of the amount of water available for cooling. SCHRAMM compressors are built in types equipped for re-cooling water (as well as for running water).

Get all the facts . . . NOW!

Write at once for complete details. Send for Catalog No. 42-S.

SCHRAMM, INC., WEST CHESTER, PA.

SCHRAMM Air Compressors

engine always runs less than 1.

However, if the charge is forced into the cylinder with super-atmospheric pressure, amount of charge can exceed displacement volume. This is called supercharging and is becoming popular for 4-stroke-cycle diesel engines.

Supercharging was first applied to 4-stroke-cycle spark-ignition aero-engines in World War I. Objective was twofold: First, to increase power. That means to reduce specific weight. Supercharging was only partially successful in that. Supercharging caused detonation and to prevent it the compression ratio had to be lowered. Net increase in power was accordingly moderate.

The other objective of supercharging aero-engines was to compensate for altitude. At high levels, the power of an engine drops considerably. It is cut to half at 34,000 ft. By supercharging at altitude the sea-level horsepower could be restored. This is possible without reducing the compression ratio and without detonation because the supercharging only maintains the compression pressure at its sea-level value.

Diesel Supercharging

In the diesel engine the main objective of supercharging is to increase power output at sea level. But the diesel does not object to increase of compression pressure the same as the spark-ignition engine does. Raising the compression pressure does not cause combustion knock in a diesel engine; if anything, it makes combustion smoother. As soon as they discovered this, diesel engineers took to supercharging as a duck to water. Now there is hardly a builder of high-output 4-stroke-cycle diesels who does not supercharge. Results in the last few years have convinced almost everybody that the supercharged 4-stroke diesel is a success.

Two methods of supercharging are the mechanically driven supercharger and the turbo-blower.

The mechanically driven supercharger may be a reciprocating, a rotary, or a centrifugal blower driven by the engine or by a separate electric motor. The blower has such a capacity that it fills the cylinders with air to a pressure that exceeds the atmospheric pressure by several psi. If the cylinder charge is, say, 25% more than that of the unsupercharged engine, gross power output also is 25% more, roughly speaking.

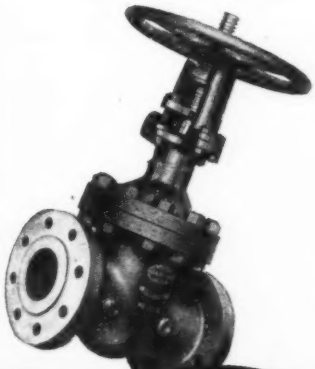
Several diesel-engine builders have adopted mechanical supercharging and achieved notable specific-weight reductions. One 150-hp 6-cyl diesel weighs 2200 lb without supercharging or 14.6

Where There's Valve Wear.. There's Worry

"Worn, leaky, faulty valves—that's one worry we don't have!" say plant operators who installed Darling Double Disc Gate Valves—many as far back as 30 years before this war.

Today valve wear can be a *real* worry because it means new valves, and they're mighty hard to get. But regardless of how severe the operating conditions, or the materials involved, Darling Double Disc Gate Valves go right on, year after year, delivering tighter seating, better performance, less wear, more efficient operation, at lowest possible maintenance cost.

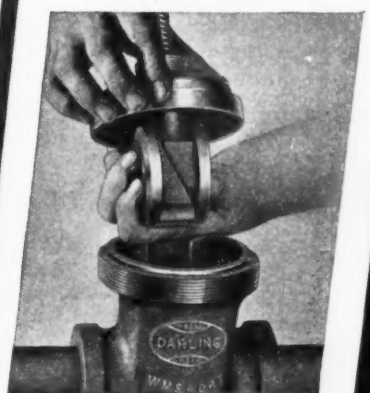
If, after long and severe service, the parts should become worn, you don't remove the valve from the line. You simply replace 4 inexpensive parts and your Darling Double Disc Gate Valve is again ready for service.



It may be difficult to get Darling Gate Valves today. Much of Darling's output has been enlisted to help float Uncle Sam's ships to victory. But replacement parts are available and new valves will be also as soon as war needs are met.

Only 4 PARTS

Two discs and two wedges—the entire working part assembly of a Darling Double Disc Gate Valve. There is no other valve with this design. The seats are parallel. The discs are *fully revolving*, seating in a different position each time the valve is operated. This means tighter seating, less wear, longer operation and lower maintenance costs with Darling Gate Valves.



You don't have to take a Darling Double Disc Gate Valve out of the line to replace the parts. Simply insert new, inexpensive parts; replace Stem and Bonnet. Valve is again ready for long, hard service.

TRADE DARLING MARK

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

For endless ways to conserve time, labor and machinery with graphite, see the 7-page booklet that's fastened to the new Know-How Graphite Containers. Besides offering a wealth of profitable graphite applications, these booklets give you detailed use-directions and much other information that guides you to get more service and economy out of graphite.

See the new containers, too, for their many illustrations and tips on graphite uses. You'll find these new Know-How packages exceptionally instructive in explaining why Dixon's graphite excels as a lubricant, pipe joint coating, heat and electrical conductor, etc.

Your supplier carries Dixon's graphites in the new Know-How containers. Or write for printed C-94.

THE NEW KNOW-HOW PACKAGE IS NOW AVAILABLE ONLY IN THE FOLLOWING SIZES:
5 lb. Ticonderoga No. 1 (Large Flakes)
5 & 10 lb. Ticonderoga No. 2 (Medium Flakes)
5 lb. No. 635 (Finely Powdered Flakes)
5 lb. Microfyne (Extra Finely Powdered Flakes)
Round all-cardboard containers will replace all-metal containers when stock is exhausted.
Other size containers of these Graphites are still being packed in the previous style packages, which will be changed as soon as the new containers are available.

JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY 3, N. J.

Canada: Canadian Asbestos Company • Montreal • Toronto • Vancouver • Winnipeg

Pipe Joint Compound • Graphite Seal • Graphited Oils • Cup and Pressure Gun Grease

Gear Lubricants • Waterproof Graphited Grease • Auto-Marine Grease • Graph-Air Guns

Lathe Center Graphite Lubricant • Belt Dressing (Contains no Graphite)

4129

lb per hp. With supercharging, the horsepower was stepped up to 200 hp and the total weight increased to 2470 lb, which makes only 12.3 lb per hp.

The economical limit of supercharging is around 30%. If this limit is exceeded the blower drive absorbs relatively more and more power and the law of diminishing returns sets in. Fuel economy also becomes poorer at high supercharge. The supercharging pressure usually runs between 3 and 5 psi in commercial mechanically supercharged engines. The most popular blower is the Roots type, but quieter and more efficient rotary blowers are in various stages of development.

Exhaust-Gas Turbines

It occurred to the French engineer, Rateau, to use an exhaust-gas turbine to drive a centrifugal blower to supercharge an aircraft engine, and some of these were put into service in World War I. Dr Moss, of General Electric Co, perfected this method, which is now used extensively in our combat planes for high-altitude supercharging. The Swiss engineer, Buchi, applied the idea to diesel engines a few years later. The Buchi turbo-supercharger hit the United States just before the present war and was an instant success. Combined output of turbocharged engines in this country exceeds 2,000,000 bhp to date. With the turbocharger the power output is stepped up 40% and more without sacrificing fuel economy. The limit has probably not yet been reached.

Buchi Turbocharger

The turbine of the Buchi supercharger is driven by the exhaust gas that discharges from the exhaust valves at an elevated pressure and temperature. Although the cylinder pressure is about 40 psi when the exhaust valve opens, the mean pressure in the exhaust pipe is seldom more than 1 or 2 psi. High back pressure seriously interferes with engine performance and must be avoided. Buchi times and combines the exhaust impulses of a multi-cylinder engine in such a manner that they convey a good part of their energy to the turbine wheel without creating an undesirable back pressure in the engine.

Temperature of the exhaust gas runs about 1000 F and turbine blades must be made of special heat-resisting alloys. The turbine drives a centrifugal blower mounted on the same shaft, which feeds the engine with air at 3 to 6 psi.

To get full benefit of supercharging, cylinders must be scavenged of the residual gas between cycles. That is accom-

(*Continued on page* 166)

Got a DRONE

Among Your Elevator Ropes?

A "DRONE" or two among your elevator ropes—a cable that isn't carrying its full share of the load—puts an extra-wear burden on the rest, uses up rope, wastes steel that America can't afford to waste!

Tension should be checked regularly!

TO EQUALIZE ROPE TENSIONS, run the elevator to the bottom of the shaft. Get on top of the car and hit two of the hoist ropes simultaneously just above the point of attachment, then immediately hold the two ropes lightly. If the wave disturbance produced in one rope travels to the top and returns sooner than in the other, the first rope is tighter, and either this should be loosened, or the other should be tightened. Compare all ropes with one showing an average tension, and adjust the others to it.

In adjusting, be careful not to twist rope. Hold socket firmly as you turn the nut on the thimble rod.

AFTER FIRST ADJUSTMENT, run car up and down and retest until, after running, the tensions remain equal. Then all ropes will be pulling equally—*and pulling their weight in our country's steel conservation program.*

IF UNIFORM TENSION CANNOT be maintained, consult your elevator service for a thorough check-up. For replacement, insist on Roebling "Traction Steel" Elevator Rope for the full measure of service that Roebling's years of wire rope engineering stand for.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

★ PROMPT SERVICE
★ on essential orders
from warehouse
★ stocks or mill

ROEBLING
"Traction Steel"
ELEVATOR ROPE

The Johnson Duo-Stat notes the outdoor temperature (bulb at right in illustration), measures the temperature of the heating system (four averaging bulbs attached to the radiator), and controls the automatic firing device or zone valve so that proper relationship between outdoor and heating system temperatures is maintained. For hot water heating, the details of the installation differ slightly.

JOHNSON DUO-STATS

Indoor comfort remains constant while Johnson Duo-Stats continuously "change the size" of the heating plant and save more fuel by always considering the outdoor temperature.

ADVANTAGES OF JOHNSON DUO-STAT CONTROL

SAVES FUEL. Except during coldest weather, only portions of the total heating capacity are used, depending on the outdoor temperature.

GUARDS AGAINST UNEVEN HEATING. "Turns the heat on" often enough to keep the mains warm at all times. Distributes heat uniformly throughout the system.

OPERATES INDEPENDENTLY OF INDOOR VARIATIONS. Open windows in certain rooms would upset the operation of ordinary controllers but do not affect the Duo-Stat. The governing factors in Duo-Stat control are the outdoor temperature and the wind action which lowers the "skin temperature" of the building.

PREVENTS COLD RADIATORS. The length of "on-and-off cycles" is varied in accordance with outdoor conditions but the "off" portion of each cycle is never long enough to permit radiators to get cold.

JOHNSON
Automatic TEMPERATURE AND AIR CONDITIONING *Control*
JOHNSON SERVICE COMPANY, MILWAUKEE, WIS. & BRANCHES IN PRINCIPAL CITIES

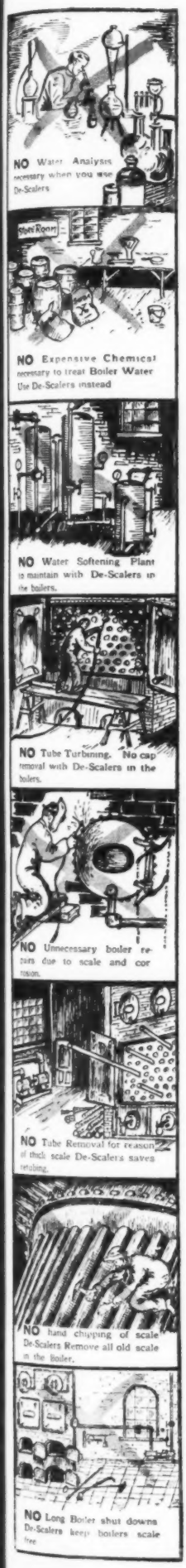
plished by *valveoverlap*. The exhaust valve is kept open a certain length of time after the inlet valve opens and the blast of fresh air supplied by the blower blows out the foul gas and fills the cylinder with pure fresh air. This also helps to keep down cylinder and piston temperatures, important in high-rating engines.

Two-Cycle Supercharging

The combination of turbo-supercharging with the two-stroke cycle engaged the attention of several inventors. One difficulty to overcome was the starting of such a unit. The engine would not operate before the turbine-blower delivered enough air to charge the cylinders. The turbine-blower would not operate before the engine discharged enough exhaust gas. To overcome the difficulty a diesel builder in Switzerland geared the exhaust turbine to the main crankshaft. This not only solved the starting problem but it was found that the exhaust turbine delivered more power than was absorbed by the centrifugal blower and thereby gave an extra boost to the power output. It is only a little step from here to use the entire engine output for supercharging *itself* and derive the useful power *only* from the exhaust-gas turbine. Such a combination is shown in Fig. 4, where a reciprocating compressor supercharges the engine to 75 psi and the exhaust-gas turbine, with no mechanical connection to the engine, furnishes the power. A turbo-blower driven by an auxiliary exhaust turbine precharges the reciprocating compressor at heavy load. With such a combination we shall have a gas turbine whose thermal efficiency is on par with that of the best diesel engines. Fig. 5 shows another design utilizing a free-piston diesel compressor which supplies exhaust gas to precompressor and turbine.

Cooling Proves Limit

At present, engine cooling puts a practical limit to the supercharging of the diesel engine. Heat rejected in a diesel is about equal to useful power obtained. The more power the cylinder delivers, the more heat has to be taken care of to prevent overheating. Sticking of piston rings, burning of pistons, cylinder heads and exhaust valves give trouble frequently in highly supercharged engines. Complete solution of these problems is a time-taking process, but progress is being made. Porous-chromium-plated cylinders and piston rings, oil-cooled pistons, sodium-cooled valves, directed high-speed water cooling and compounded lubricating oils are a few of the recent developments in this direction.


NO Water Analysis necessary when you use De-Scalers
NO Expensive Chemical necessary to treat Boiler Water Use De-Scalers instead
NO Water Softening Plant to maintain with De-Scalers in the boilers.
NO Tube Turbining. No cap removal with De-Scalers in the boilers.
NO Unnecessary boiler repairs due to scale and corrosion.
NO Tube Removal for reason of thick scale De-Scalers saves retubing.
NO hand chipping of scale De-Scalers Remove all old scale in the Boiler.
NO Long Boiler shut downs De-Scalers keep boilers scale free

8 Losses

BOILER OPERATIONS DISPOSED OF

With Butler DE-SCALERS*

IN THE BOILERS

De-Scalers Are Keeping Thousands of Boilers Permanently Free of Scale and Corrosion Without the Use of Chemicals.

ECONOMICAL

De-Scalers provide the most economical and efficient water treatment ever devised. Their action is positive and their performance in all types of boilers will stop scale and corrosion.

REMOVES OLD SCALE

De-Scalers will maintain in your boiler a constant mineral-free water. With this condition prevalent, it is an impossibility for new scale to form.

All old scale in your boiler at the present time will be removed due to the De-Scaler's positive action.

NO TUBE TURBINING, NO HAND SCALING

De-Scalers eliminate the need of tube turbining and other mechanical means of scale removal or the use of expensive chemicals that more often than not have failed to keep your boilers scaleless and free of corrosion.

QUICKLY AND EASILY INSTALLED

De-Scalers are fully automatic, have no moving parts, and require no adjusting.

Wide variations in the mineral content of the water used in no way affect the De-Scalers in the prevention of scale forming in the boiler.

No water analysis necessary.
Definitely stops scale formation.
Positively causes the removal of old scale.
Stops foaming and priming.
Prevents electrolytic and oxygen corrosion.
Will not harden soft packing.
Will not corrode metallic packing.
Eliminates hand scaling, tube turbining.
Will maintain a proper pH value.
No long boiler shut down for cleaning.
No chemicals or Boiler Compound needed.

All De-Scalers used in accordance with our instructions will fulfill the above.

ANYWHERE

Satisfactory water correction can be obtained anywhere with De-Scalers; so, if you have a water correction problem, and if you want the maximum of protection and assured satisfaction, use Butler De-Scalers in your boilers.

Send for booklet "Presenting Butler De-Scaler"

Patented; other patents pending. Trademark Reg. U. S. Patent Office.

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926 Magazine Street **P. O. Box 1699**

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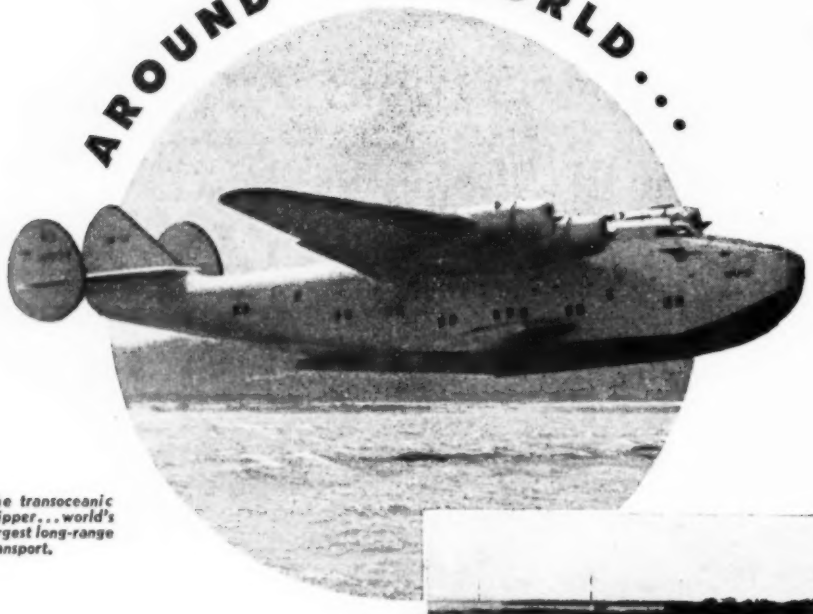
ROPER ROTARY PUMPS
with Pan American
AROUND THE WORLD...



The transoceanic Clipper... world's largest long-range transport.

That Pan American is able to serve the United Nations throughout the world, is due in large measure to the fourteen years of pioneering and scientific progress which have gone into the development of its facilities.

To meet the exacting demands of this great air transport system all mechanical equipment must function efficiently . . . must be dependable . . . must require a minimum of servicing.

Roper Rotary Pumps meet these requirements . . . that's why they are the choice of Pan American. The simple principle of Roper Pumps . . . only 2 moving parts . . . equal size pumping gears operating at the same speed . . . assures quiet and smooth operation with less vibration and a minimum of wear.

IN BRAZIL

IN AFRICA

AT LA GUARDIA FIELD HANGAR

ON FIRE FIGHTING UNITS

Write for Catalog 944
A summary of factual information on pumps and pumping problems.

GEO. D. ROPER CORP., ROCKFORD, ILLINOIS

ROPER *Rotary* PUMPS

Boiler-Feed Pumps

(*Continued from page 93*)

rise through the pump is limited to about 15 F for a flow of 30 gpm per 100 bhp of pump power at shut off. Heat to be transferred amounts to about 250,000 Btu per hr per 100 bhp of pump power at the capacity corresponding to the bypass flow.

To recover this heat, the cooling medium can well be the condensate itself withdrawn from the condensate-pump discharge and returned to the direct-contact heater. If this is impracticable, the heat exchanger can be located after the main turbine oil coolers with circulating water as the cooling medium. The heat exchanger can be incorporated in the base plate of the pump in some instances; in any event, it should be close to the pump.

Referring to Fig. 2, note that the pressure-reducing orifice and control valves are located upstream of the heat exchanger. This arrangement precludes ever subjecting the heat exchanger to pump discharge pressure.

The recirculating bypass serves another function in addition to protecting the pump against overheating. Internal losses and disturbances within a centrifugal pump increase as flow decreases. At extremely light flows, these hydraulic disturbances are frequently of sufficient magnitude to manifest themselves mechanically in the form of vibration and pulsation.

Vibration Injurious

Vibration is definitely injurious to pump life as well as satisfactory operation. Stuffing-box packing can be made to operate satisfactorily at high pressure as long as the pump is well balanced and free of vibration.

The recirculating bypass increases flow at times of low load and thus helps decrease any possible vibration conditions.

With the recirculating bypass of Fig. 2. no problem of balancing leakoff return is presented as this water can be introduced into the bypass line ahead of the heat exchanger and cooled before return to the pump suction. If no recirculating bypass is used, however, the balancing leakoff cannot be conveniently returned to the direct-contact heater for the same reasons it is impossible to return the bypass flow.

In this situation, it is entirely practicable to return the leakoff to the pump suction through a small heat exchanger.

(*Continued on page 172*)

INDUSTRY'S MOST "FLEXIBLE" WEAPONS

NOT all of the weapons for waging this highly mechanized war are on the fighting fronts. Thousands upon thousands of them are winning a production war in America's industrial plants . . . 24 hours a day . . . seven days a week.

Such production calls for "weapons" of extreme flexibility in use and construction to withstand the continuous grind.

Outstanding among such "weapons" are the products of this company . . . American Flexible Metal Hose and Tubing . . . products which serve in almost every major industry.

And by "Flexible" we mean just that. Flexible in use, flexible in construction and serviceable for a thousand duties. There's no substitute for metal in its ability to convey oil, steam, hot water, gas, solvents, chips, dust, etc. . . . Other materials will perform *some* of these duties . . . other materials *are* flexible. But metal alone has the strength for endurance, the characteristics to withstand heat and cold, abrasion and vibration. Its Flexibility . . because of American's construction methods . . . is available in any degree required for the duty to be performed and, in the case of Seamless, there are records of many millions of flexings, without breaking.

Shown in the top illustration is American "Seamless", the bronze tubing without welds, joints, laps, seams or packing . . . as leakproof as the rigid seamless tube from which it is corrugated. Its resistance to pressure is increased by an armor of one or more wire braids.

American Interlocked hose, also pictured, is asbestos packed for heavy duty and severe service . . . bronze for steam and steel for oil. Also in light weight and unpacked for air, gases and light dry materials.

When the changeover to peacetime production takes place, you will find American products on the production lines in every conceivable use. Plan now . . . ask for descriptive bulletins on "Seamless" or any other type of flexible hose or tubing with American's dependable metal construction.

ANACONDA
from mine to consumer

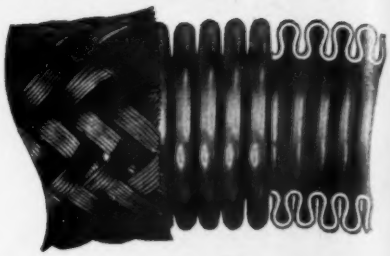
AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • • Subsidiary of Anaconda Copper Mining Company

In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

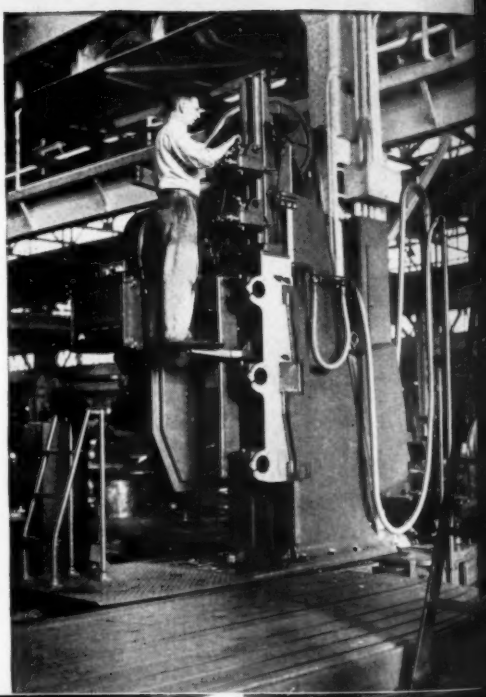
DEPENDABLE ACTION

BECAUSE IT'S *Flexible*



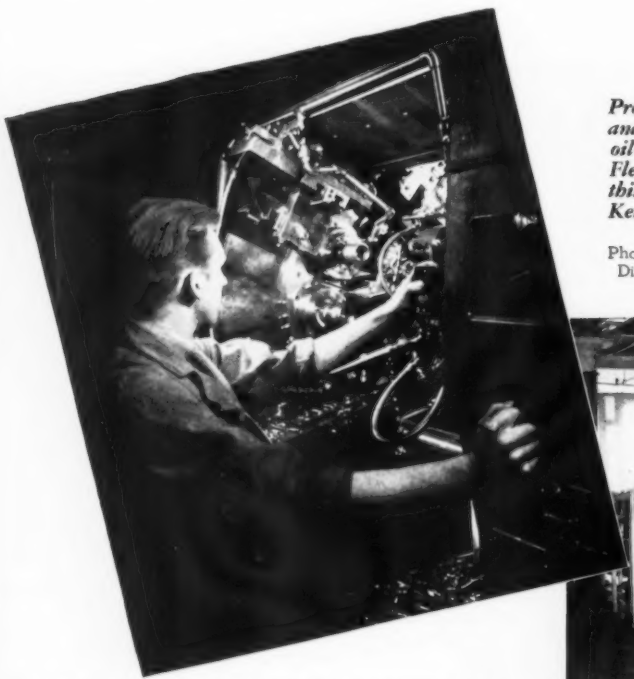
Above: American Seamless Flexible Metal Tubing—B
Below: American Interlocked Flexible Metal Hose—

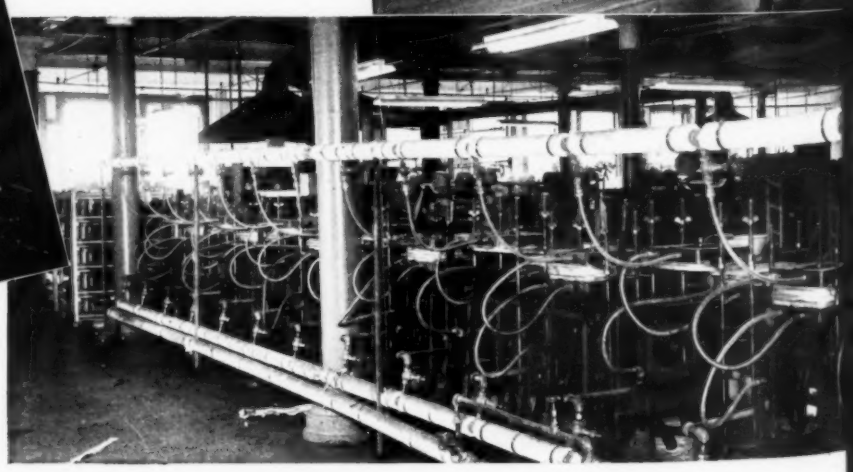
For conveying air, water, oil, steam or fuel where flexibility is required, there is *nothing* more dependable than flexible metal hose and tubing. Illustrated here are some typical installations of American Seamless—a few of a seemingly endless range of applications. Using almost any workable metal, we can build a flexible hose or tubing from a simple spout to a high pressure seamless hydraulic line. Whether you need a flexible connector for misaligned or moving parts, for isolating vibration, or for conveying fluids, you'll likely find we have a flexible metal hose or tubing that will do the job dependably and economically.



Protecting the electric power and control cables from chips, oil and grease is the job of this Flexible Metal Hose conduit on this huge, but precision-built, Keller Machine Tool.

Photo Courtesy of Pratt & Whitney, Division of Niles-Bement-Pond Co.





Above: American Oil Feed and Coolant Tubing lubricates the work on machine tools.
Right: Live steam being fed through American Seamless to hat forming presses.

American Metal Hose

ANACONDA
from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. · · Subsidiary of Anaconda Copper Mining Company

In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

In 1937

we said this ➔

CARBORUNDUM
SIX YEARS–NO REPAIRS
and still going strong
•In the Spring of 1930 this "Carbofrax" lining was installed in an Eastern plant in a 300-hp. hand fired boiler operated at 150% of rating. Before they put in "Carbofrax" Brick, major repairs of the linings were necessary at least once a year. This was expensive because of loss of steaming capacity during shut-downs and increased labor and maintenance charges.
For six years the "Carbofrax" lining has been going merrily along and as the photograph indicates it is good for several years more service.
Yes, a lining of "Carbofrax"—the Carborundum Brand Silicon Carbide Refractory—is a dependable lining.
THE CARBORUNDUM COMPANY, REFRACTORY DIVISION, PERTH AMBOY, N. J.

IMAGINE more than eleven years' service from the "Carbofrax" brick in this setting!

But a long life hasn't been the only benefit enjoyed by this operator. Freedom from clinker adhesion—elimination of major lining repairs at inopportune times—increased efficiency through maintenance of full effective grate area—have been among other outstanding, money-saving advantages to him.

"Carbofrax" has made these results possible because of its extremely high refractoriness—exceptional resistance to spalling, cracking and clinker adhesion.

For a dependable setting use "Carbofrax." Our engineers will be glad to discuss the matter with you.

"Every hour this war is shortened will save $12,000,000. The lives it will save are priceless. Let's get it over with—quickly!"

REFRACTORY CARBORUNDUM PRODUCTS

Refractory Division, **THE CARBORUNDUM COMPANY,** *Perth Amboy, N. J.*

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District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Firebrick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fire Clay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.

(Carborundum and Carbofrax are registered trade-marks of and indicate manufacture by The Carborundum Company)

YARWAY

INVOLUTE SPRAY NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from 1/4 in. to 2 1/2 in. Write for Catalog N-616.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

The heat exchanger may even be located in series with the oil cooler that serves the bearing-oil supply, Fig. 3, as only a small quantity of cooling water is required and a high rise for the cooling water, of the order of 100 F, can be utilized.

Venting Suction Piping

Another condition that requires specific provision in the design of a boiler-feed pump installation where one standby unit may be called on alternately to serve two or more main turbines is the need for venting suction piping on the pump side of the suction valve. Should the standby pump be taking water from a direct-contact heater operating at a higher pressure than a neighboring unit and then be required to switch to a lower pressure suction condition, water within the pump will be at a higher temperature than that corresponding to the new suction pressure. Flashing can occur in the suction line with resulting steam binding of the pump or even of the suction header.

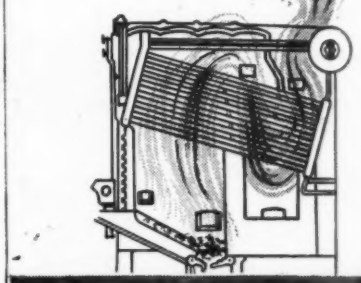
Connect Vent Line

To avoid this risk, a vent line is connected from the suction piping on the pump side of the suction valves leading to some point in the system that is always at a lower pressure than any of the direct-contact heaters, for example, directly to one of the main condensers.

This vent line need be equipped with only a manually operated valve, see Fig. 4, and a pressure gage to give the operator an indication that the pressure within the pump is below that of any of the direct-contact heaters. When the pump is brought to a standstill, after the suction and discharge valves have been closed, the vent valve is opened for only the few seconds necessary to bring pump temperature down to a safe value by flashing some steam to the condenser. The vent valve should be closed, however, before pressure within the pump falls anywhere near condenser vacuum as this would cause pump temperature to fall below that consistent with rapid restarting of the pump.

Since the flashing operation is quite rapid and manual control of the pressure within the pump is far from foolproof, it may be preferable to interspose a spring-loaded pressure-reducing valve in the vent line, as indicated in Fig. 4. This valve, set at a few psi above atmosphere, automatically cuts off the vent when pressure within the pump has been reduced to the proper value.

XZIT means OUT



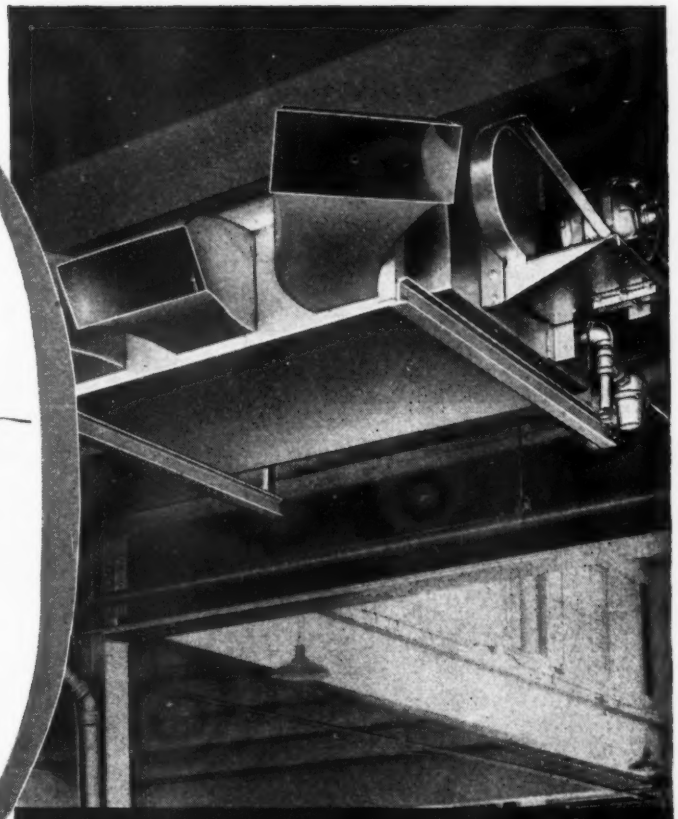
Removes Soot and Fire-Scale WITHOUT a SHUTDOWN

To a long list of consistent users, XZIT means complete freedom from soot and fire-scale. While XZIT is not always a substitute for blowing or brushing tubes, it does reduce these deposits chemically so they can be dissipated easily without a shutdown for chipping and scraping. In many cases, after using XZIT, soot residue is drawn out by natural draft, and fire-scale drops off by itself.

XZIT is fed into the fire-box, and cleans while the boiler operates. Continued use prevents further carbon accumulation, increases heat transfer, reduces smoking, and saves maintenance time and labor. Get the facts today.

XZIT SALES CO.
1031 Clinton St., Hoboken, N. J.

STOP
COLD WEATHER
ABSENTEEISM



Suspended type Unitherm Unit Heater — no floor space needed — easily installed. Note SQUARE OUTLETS which are quickly adjustable for 4 different directions of heat flow. All Unitherm type heaters are equipped with centrifugal fans — one for each outlet. This means heat delivered at HIGH VELOCITY over wide areas — fewer units required.

USE

CLARAGE
UNIT HEATERS

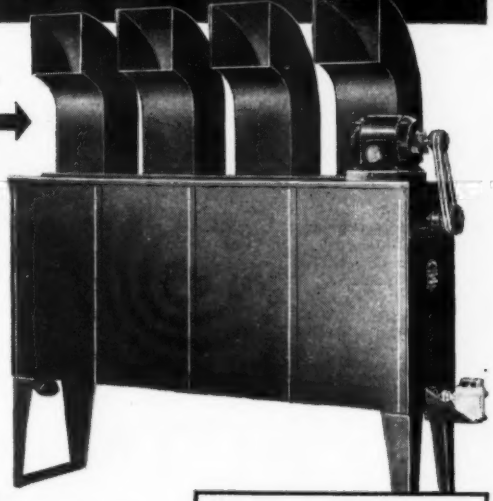
AND KEEP YOUR PRODUCTION IN HIGH GEAR THIS WINTER

Check your heating NOW! Don't let common colds and other winter ailments, due to inadequate heating, cause a sharp rise in absenteeism among your workers.

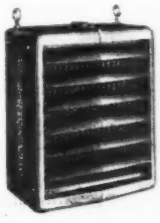
* For keeping any type of industrial plant warm and comfortable — an entire building or any part of it — Clarage Unit Heaters offer many important advantages.

* They meet temperature, time and space requirements with precision exactness. You get the heat you need where you want it, and when you want it! You save in first cost. And the entire installation job is simple; inexpensive.

* *Built in 37 sizes (96,000 to 1,000,000 B.t.u.), operating on steam or hot water. Performance guaranteed — thousands of units in service. Prompt deliveries now possible. No obligation to have Clarage engineers submit complete recommendation — write, wire or phone us today!*



Floor type Unitherm Unit Heaters simplify your layout — save piping and trap costs. All parts readily accessible by removing front or back section of heater casing. V-belt drive permits flexibility of fan speed; assures quieter operation.



Small propeller fan unit heaters for places where more heat is wanted — to help out present equipment. Easily installed along side walls or at ceiling line.

INVEST IN VICTORY: Buy More War Bonds!

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
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FACTORY HEATING
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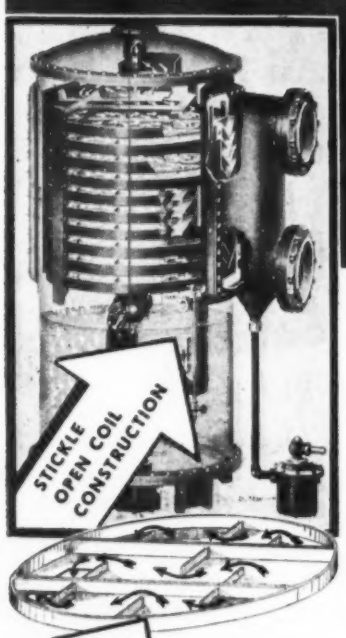
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

STICKLE
OPEN COIL
FEED WATER HEATERS

No. 12 Stickle Open Coil Heater and Purifier, Deaerating Type, cast iron heater mounted on horizontal steel storage tank, installed in an eastern plant during August, 1943. Heating capacity, 125,000 lbs. per hour. Storage capacity, 3,000 gallons.



1 **Heat Water to Higher Temperature in Less Space.** Bring water into direct contact with steam. Instantaneous transmission of heat from steam to water. Delivers feed water to pump within two degrees of temperature of saturated steam in heater.

2 **Supply Better Quality of Feed Water.** All steam condensed in heating feed water becomes part of boiler feed supply. Large portion of total boiler supply absolutely free of scale-forming substance.

3 **Control Admission and Overflow Automatically.**

4 **Perform Indefinitely Without Repairs.** Trays easily removed for cleaning. Water does not overflow sides of trays. Scale-forming substance does not accumulate on side-walls of heaters.

5 **Available in 10 Standard Sizes** in Single Heaters, capacity range, 3,000 lbs. to 130,000 lbs. Dual Heaters in six standard sizes, capacity range, 30,000 lbs. to 250,000 lbs. Deaerating and non-deaerating types.

Stickle Bulletin No. 117 fully describes Stickle Open Coil Construction and illustrates various sizes and constructions. Mailed on request.

STICKLE

STICKLE STEAM SPECIALTIES CO.
2265 VALLEY AVENUE, INDIANAPOLIS, INDIANA

Installing Large Motors

(*Continued from page* 93)

be tamped thoroughly under the bedplate. Fabricated bedplates are preferably grouted to the web of the H-beam, as in Fig. 3. Grout rails to within one-half inch of their top. Mix and pour grout without interruption and as rapidly as possible.

Coupling alignment. Accurately align the motor with its connected mechanical load so that shaft stresses, vibration and coupling wear are reduced to a minimum. Check rigid couplings for alignment and truth by loosening the bolts and measuring with thickness gages between the coupling faces at four equally spaced positions around its periphery. Make alignment accurate enough to give no more than 0.002 in. variation between coupling faces, per 12 in. of face diameter. When checking alignment, make sure the pilot fit in the coupling does not affect alignment measurements.

Do not force flexible couplings to take misalignment that causes excessive wear and may cause vibration. Align Fast flexible couplings by checking between coupling hub faces with feeler gages and with straight edges from one hub cylindrical surface to the other.

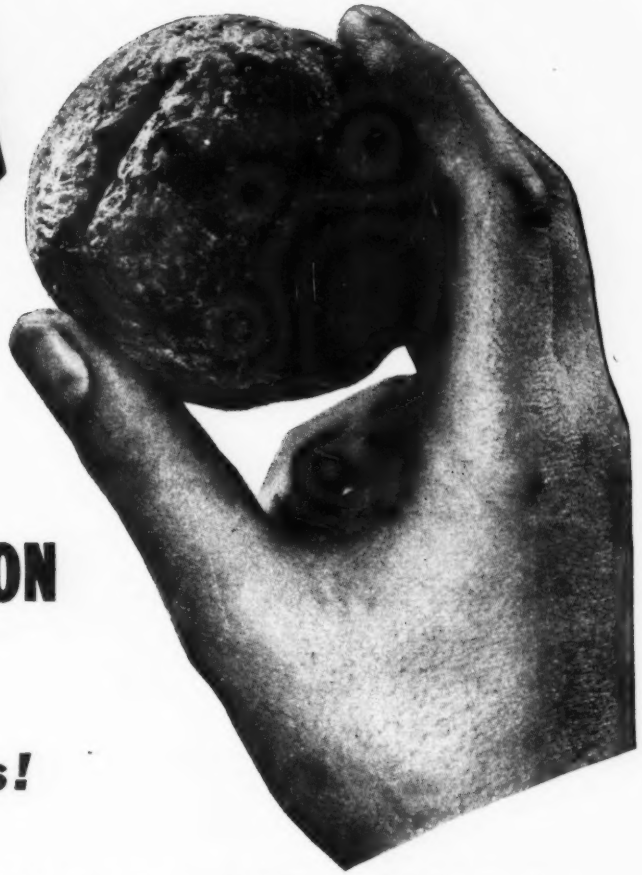
Use Dial Indicators

Use dial indicators when flexible couplings are not arranged so that their alignment can be checked readily. Mount the indicator on one shaft and read radial as well as axial variations between the coupling halves as they revolve slowly together. Where the two coupling halves float axially, use two indicators mounted 180 deg apart, and check the angular alignment by the difference in the two axial readings.

Assembly of engine-type machines. Check spider bore and shaft diameter against each other to make sure that proper allowance has been made for the press or shrink fit. Also, check dimensions of the keys against the dimensions of the keyways. Before fitting any type of rotor spider to the shaft, remove all slushing compound with kerosene or other solvent.

Split rotors. Rotor-spider halves are fastened together by bolts at the hub, while shrink links are sometimes used at the rim. Place the two halves in position and bolt together. To facilitate tightening the nuts on large spiders remove bolts, when possible, one at a time, heat to approximately 212 F and put them back in their holes and again

FACTS YOU MAY NOT KNOW ABOUT EAGLE MINERAL WOOL INSULATION



EAGLE SUPER "66" INSULATION INHIBITS RUST

—*razor blade test shows!*

Bury a shiny new razor blade in a wet ball of Super "66"—Eagle-Picher's outstanding Insulation for temperatures up to 1800° F. Let ball and blade stand several weeks. When removed, notice how free from rust the blade is.

No trick of parlor magic . . . but proof positive that this insulating cement is not merely non-corrosive, but actually helps inhibit rust! And its insulating efficiency is remarkably outstanding.

Springy Ball Structure

Secret of the sensational insulating efficiency of Eagle Super "66" lies in the springy pellets of Eagle Mineral Wool that are its basic ingredient. *After* the insulation is applied, this springy structure is still retained. Pellets contain millions of dead air cells which do not crush down. Full efficiency is maintained—coverage is increased, and shrinkage held to a minimum.

All Purpose—and it's Reclaimable

Eagle Super "66" can be applied to practically all heating equipment. It requires no special tools; exceptional workability means low installation cost. And when used on temperatures up to 1200° F., it may be removed, reworked and reused if desired!

We will send on request full particulars on Eagle-Picher High Temperature Insulations, and show how they will save you money and fuel. Current demand is very heavy, but we are endeavoring to fill all orders without undue delay.

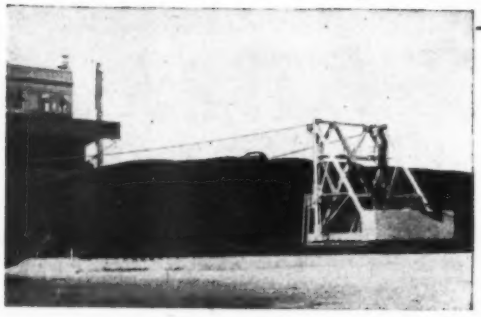
EAGLE-PICHER HIGH TEMPERATURE INSULATIONS

Eagle Super "66" Plastic Insulation
Eagle Supertemp Blocks
Eagle L-T Felts
Eagle Blankets

EAGLE 1843 EP 1943 PICHER

Eagle Finishing Cements
Eagle Loose Wool
Eagle Insulseal
Eagle Insul-stic

THE EAGLE-PICHER LEAD COMPANY, Cincinnati, Ohio



STORE MORE COAL

Pictured above is a stockpile at a 160,000 kw. generating plant where a 7 cu. yd. Sauerman Power Drag Scraper handles an average of one million tons of coal per year, both storing and reclaiming. Typical of all Sauerman installations of large capacity is the self-propelled tall tower shown in the foreground. This tower, governed by remote electric control, provides rapid automatic shifting of the scraper to any part of the storage area.

Stockpiling of coal on a larger scale than ever before in history is necessary to insure maintenance of the present production schedules of industry.

To meet this need, Sauerman Power Drag Scrapers are being installed at numerous plants throughout the nation, in some cases to provide coal storage where none existed before; in others, to expand existing storage facilities at low cost.

A Sauerman Scraper stores and reclaims safely, rapidly, cleanly—for only a few cents per ton. Builds a homogeneous pile in compact layers, free of combustion hazards. Operates with a minimum of champing across pile and avoids dirt and dust of heavier equipment.

Sauerman Advantages:

- Low-cost equipment
- One man operation
- Greater safety
- Higher stockpiles
- Upkeep simple
- Adjustable to any space

Write for free "Coal Storage" Manual

SAUERMAN BROS., INC.

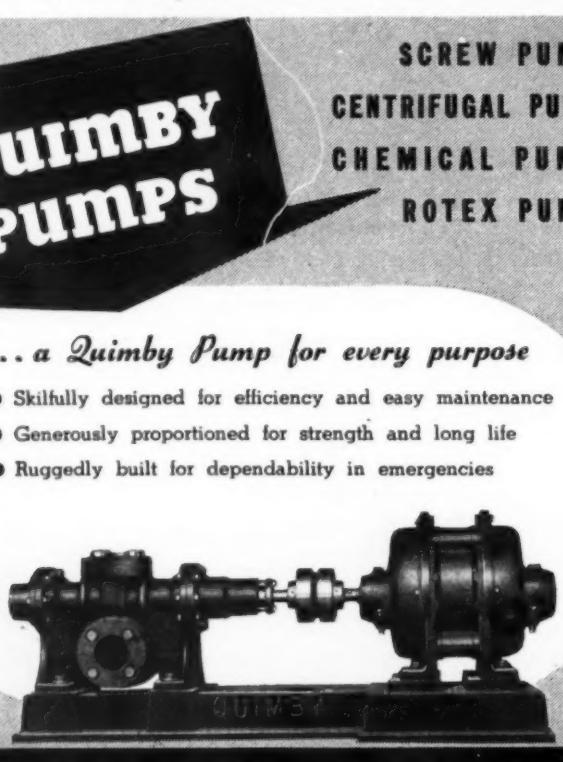
562 S. CLINTON ST. CHICAGO 7, ILL.

QUIMBY PUMPS

SCREW PUMPS
CENTRIFUGAL PUMPS
CHEMICAL PUMPS
ROTEX PUMPS

... a Quimby Pump for every purpose

- Skilfully designed for efficiency and easy maintenance
- Generously proportioned for strength and long life
- Ruggedly built for dependability in emergencies



PORTER Better-Built Equipment Established 1868

QUIMBY PUMP COMPANY

INCORPORATED

Division of H. K. PORTER COMPANY, Inc.

GENERAL OFFICES: PITTSBURGH (1), PENNSYLVANIA

FACTORIES: PITTSBURGH AND BLAIRSVILLE, PA. NEWARK AND NEW BRUNSWICK, N. J.

tighten. Dowels are usually provided to align the halves of the spider. Always check this alignment before tightening bolts.

When shrink links are used, tightly bolt the spider together at the hub before inserting the links heated to not more than 660 F. At this temperature they slip easily into place. They are not interchangeable, each being numbered to correspond with the slot in which it fits.

Solid rotors. Assemble on the shaft by first expanding spider with heat. If the poles and field coils are mounted on the spider, apply heat to it only to protect rotor insulation. If these parts are not in place, heat the entire spider uniformly. Inclosing spider in a temporary housing facilitates heating. Experience shows that the proper degree of expansion is obtained by heating the spider to 300 F. Exceeding this temperature may cause permanent distortion. To avoid contraction stresses, let the assembly cool uniformly after the rotor has been located on the shaft.

Adjusting the air gap. After the rotor has been placed in the stator, adjust the air gap. Line up the stator core with the rotor poles to avoid end thrust. The mechanical center is not necessarily the magnetic center. End thrust is eliminated by adjusting the stator axially before doweling. Equalize the gap at the vertical center-line by placing shims under the frame feet, and at the horizontal center-line by moving the stator along the rail or bedplate.

Measure the Air Gap

Measure the air gap in at least four equally spaced points about the rotor's circumference by feeler gages long enough to obtain an average reading to the core's center, as measured from each end. If the core is more than 30 in. long, use a feeler gage that extends at least 15 in. at each end into the air gap, which is adjusted until diametrically opposite measurements are within 10% of each other. If the air gap is not uniform, the unbalanced magnetic pull may overload the bearings.

Doweling the stator. Motors furnished with a bedplate have their stators doweled in place at the factory. Motors mounted on rails or on the customer's bedplate, are doweled when installed. Drill and ream dowel holes and insert dowel bolts only after the stator has been aligned and adjusted axially to eliminate end thrust.

Dowel bolts maintain motor parts in alignment and help realign motor after making repairs.

Starting and operation. Connect the

POWER NEEDS PROTECTION TOO!

TODAY war industries are guarded night and day by watchful plant policemen; vital power station equipment is protected by high barbed wire fences; powerful floodlights are on the alert to expose any saboteurs; but how about the wiring in your power plant? Power needs protection too—

And there's no better protection for general wiring in power plants where operating conditions are severe than Deltabeston Asbestos-insulated Wires and Cables. Deltabeston is built to withstand peak-load production day in and day out, the year round. Where excessive heat, high humidity and corrosive vapors play hob with electrical equipment, Deltabeston performs with the utmost dependability.

Here are just a few of the numerous Deltabeston Cables with the heat-resistant insulation which are helping to speed the day of Victory:

Deltabeston Power Cable Types AVA or AVL for general wiring in power plants, steel mills, boiler rooms and in other torrid zones where constant high temperatures prevail. Insulated with felted asbestos, varnished cambric insert and asbestos braid or lead sheath.

Deltabeston Switchboard and Hinge Cable Types AVB or SNA for wiring swinging panel connections, general switchboard and all other types of control apparatus. Insulated with varnished cambric or extruded synthetic, felted asbestos, flame-proof braid finish.

Deltabeston Boiler Room Wire Type AVA for wiring in central stations, steel mills, boiler rooms and other installations where resistance to high ambient temperatures is required. Insulated with felted asbestos, varnished cambric insert and asbestos braid.

HERE'S THE ANSWER TO YOUR WIRING PROBLEMS WHERE HEAT ENDANGERS.

It's yours for the asking. Write to Section Y1033-52, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. Deltabeston Wires and Cables are distributed nationally by Graybar Electric Co., General Electric Supply Corp. and other G-E Merchandise Distributors.

GENERAL ELECTRIC

For V-DAY BUILDING

BENEFIT BY CONNERY V-STIFFENED NON-BUCKLING LEAKPROOF BREECHINGS . . . .

We take pardonable pride in the fact that 100% of Connery output is going to war production projects. And we feel certain that the many plants using (and planning to use) Connery's Improved Expansion Stiffened Construction for stacks, breechings, ducts, etc., won't mind if we give our best to "our first customer," Uncle Sam.

As government priority construction slackens, however, we will be in a position to offer old and new customers specific help on their problems of power plant construction.

STACKS
•
BREECHINGS
•
UPTAKES
•
HOPPERS
•
AIR DUCTS

RECENT INSTALLATIONS

NEW HAMPSHIRE GAS & ELECTRIC CO.	PORTSMOUTH, N.H.
UNITED ILLUMINATING CO.	BRIDGEPORT, CONN.
ROCHESTER GAS AND ELECTRIC CO.	ROCHESTER, N. Y.
INDIANAPOLIS POWER & LIGHT CO.	INDIANAPOLIS, IND.
CONSOLIDATED GAS ELEC. & LIGHT PR. CO.	BALTIMORE, MD.
VIRGINIA PUBLIC SERVICE CO.	ALEXANDRIA, VA.
U. S. NAVAL TRAINING STATION	GREAT LAKES, ILL.
HENRY DISSTON SONS	PHILADELPHIA, PA.
QUARTERMASTERS DEPOT	PHILADELPHIA, PA.

CONNERY CONSTRUCTION CO.
Second and Luzerne Sts. Philadelphia, Pa.

CONNERY
EXPANSION STIFFENED
CONSTRUCTION

motor according to the diagram furnished with the control equipment. To reverse direction of rotation of a standard 3-phase motor interchange any two leads. To reverse direction of rotation of a 4-wire 2-phase motor, interchange the leads of one phase; of a 3-wire 2-phase motor, interchange the two outside leads. Install all wiring in accordance with the National Board of Underwriters' requirements and local regulations. Frame of the motor should be grounded to protect the operator in case of stator-winding insulation failure.

All motors having straight radial blowers for circulating ventilating air are suitable for either direction of rotation. Two-pole motors always have inclined blade or propeller blowers and are suitable for only one direction of rotation. A rotation plate shows direction of rotation.

Starting all motors. Before starting the first time, carefully observe the following instructions: (1) Be sure that voltage and frequency on the nameplate correspond with that of the power line. (2) See that all connections are properly made. (3) Fill bearings with a good grade of lubricating oil to height indicated on gage. (4) Inspect all electrical clearances. Be sure brush shunts do not touch. (5) Carefully examine motor interior, coil ends, air gap, slip rings, spider, and the spacer between poles for loose objects, such as bolts, nuts and tools. (6) Check all moving parts for sufficient clearance with the nearest stationary part. (7) If possible, turn the rotor by hand to see that it rotates freely. (8) As soon as machine starts see that the oil rings are turning and feeding oil to the bearings.

Additional Requirements

Starting synchronous motors. Observe these four additional requirements when starting synchronous motors: (1) See that the damper winding segments of engine-type machines assembled in the field are connected at the split and the nuts tightened. (2) Be sure the field switch short-circuits the field coil through the resistance provided for that purpose. (3) After starting and when constant speed has been reached, close the field switch to apply excitation voltage to the field winding. (4) Adjust field current to the value marked on motor nameplate, which will give rated power factor at rated load.

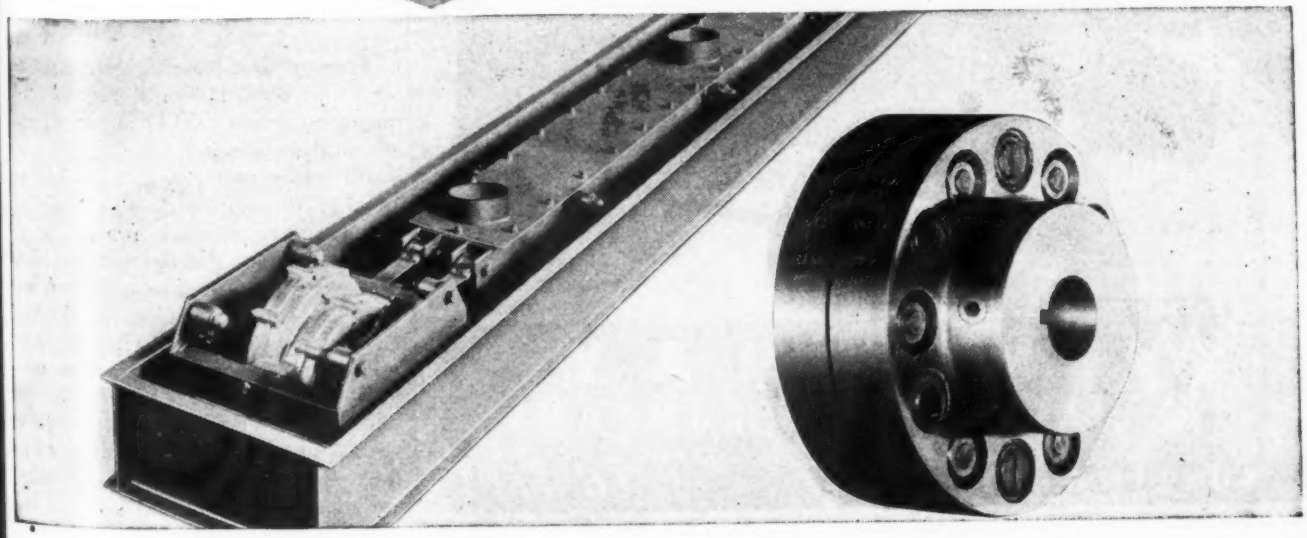
Starting wound-rotor induction motors. (1) Be sure that the correct value of resistance is connected in the secondary circuit. (2) Never apply a wound-rotor motor to plugging service unless designed for it.

FOR *Excellence*

AJAX

FLEXIBLE COUPLING CO.

WESTFIELD, N. Y. **Incorporated 1920**



Design that provides—

★ **A longer steam ring with greater nozzle area**

★ **Larger steam inlet size**

★ **Larger exhaust opening**

★ **Additional hand valves and improved efficiency**

THE type "UV" parallels the design of the type "U" single stage turbine. It has the same unique and patented arrangement of the casing which is split horizontally well above the shaft centerline.

Picture shows the unit equipped with mechanical shaft type main speed governor and hand speed changer. The standard center lines exhaust end support and flexible steam end support are also shown.

MURRAY

Type UV Multi-Stage

MECHANICAL DRIVE TURBINE

Can, if desired, be provided with oil relay governor either of the constant or variable speed type as well as extraction or extraction mixed pressure gear.

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

To Prevent Fire

(*Continued from page 8*)

eye and remember that the worst error of all may be made when buying the extinguisher. Don't make the mistake of selecting the wrong type or one too small for the probable blaze. Be sure extinguishers are tested and approved by the Underwriters Laboratories or Factory Mutual Laboratories.

Only high priority holders can get standard equipment now, but laboratories are giving temporary approval to equipment of non-critical material, which can be recognized by the EAS (Emergency Alternate Specifications) designation on the label.

When selecting and distributing extinguishers, don't overlook freezing or overheating dangers. A water-filled unit becomes useless at freezing temperatures which are apt to occur this winter when heat will be reduced or cut off to save fuel. However, a pressure extinguisher such as carbon dioxide, located near a heater or in a room where temperature may rise to 135-150 F, will open its relief valve and waste the extinguishing agent.

Use firefighting equipment properly. The best equipment available does not extinguish fire unless it is used properly. Classroom instructions give only part of the training. Only experience through regular practice develops the confidence to know what to do and the skill to do it. This means holding periodic demonstrations with real fires in a suitable outdoor area, simulating actual plant conditions, because extinguishing fire with the proper agent gives firemen a *feel* of the apparatus that they get in no other way. They soon learn to know an extinguisher's capacity and that a fire may be too big to handle with a first-aid unit.

Varying fire hazards. Fire hazards vary in potentiality throughout the plant. Some are readily apparent, others easily overlooked.

Oil under pressure in a broken or cracked line will squirt on a steam pipe a considerable distance away.

Look out for deterioration of what was once adequate protection against fires in outdoor equipment. Broken stone fill around transformers cools overflowing oil below its ignition temperature, but weeds and grass that are allowed to cover the stones destroy their value. An otherwise good transformer water-spray system is useless if nozzles are plugged by scale or insect nests.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Facts on Causes of Corrosion First Step in Tube Conservation

Precautionary Measures Taken in Time Will Often Forestall Condenser Tube Failures

In these times, when tube replacements cannot readily be made, an understanding of corrosion and its causes will do much to forestall tube failures. An up-to-date survey of the mechanisms of the various types of corrosion is being published as a continued story in this and future issues of the COPPER ALLOY BULLETIN.

Two Types of Films

In the last issue it was pointed out that corrosion films forming on metals may be divided into two classes: visible, non-protective films, and invisible, protective ones. A number of films have characteristics between these two extremes.

The visible films (generally non-protective) which are insoluble in the corroding medium, usually have the following characteristics:

(1) Permeable to water.

(2) Dense enough to impede the flow of fresh corrodent to the metal surface which may slow up the corrosion rate.

(3) Discontinuous—permitting the corrodent to come in contact with the metal in some areas and partially screening it in others.

(4) Capable of increasing the corrosion rate in certain screened areas by the formation of concentration cells which become pits.

(5) May grow or increase in thickness, thereby accelerating the pitting action or enlarging the area being corroded.

Pitting, Deposit Attack

The above mentioned characteristics of visible corrosion films aid in the formation of the concentration cell type of corrosion, commonly referred to as pitting, plug type dezincification and deposit attack. The concentration cell begins to operate when the corroding substance is present in different concentrations at adjacent areas on the metal surface. Deposits of slime from various growths, silt, shells, sand, etc., are also contributors to deposit types of corrosion.

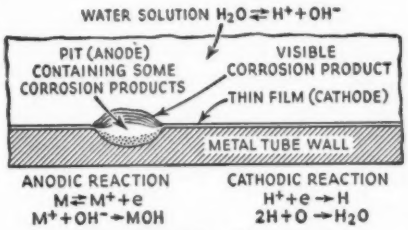

WATER SOLUTION $H_2O \rightleftarrows H^+ + OH^-$
PIT (ANODE) CONTAINING SOME CORROSION PRODUCTS
VISIBLE CORROSION PRODUCT
THIN FILM (CATHODE)
METAL TUBE WALL
ANODIC REACTION
$M \rightleftarrows M^+ + e$
$M^+ + OH^- \rightarrow MOH$
CATHODIC REACTION
$H^+ + e \rightarrow H$
$2H + O \rightarrow H_2O$

Diagram illustrating the mechanism of pitting type corrosion.

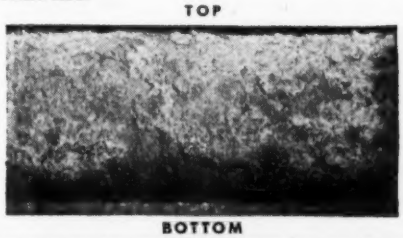
Engineers know that the removal of such debris prolongs the life of condenser tubes as the metal is always corroded (anodic area) where the oxygen concentration is least.

Where no deposit covers the metal (cathodic area) and therefore the oxygen concentration is the highest, since the film is more permeable to oxygen, the hydrogen formed by the reaction $M + HOH \rightarrow MOH + H$ will be readily removed, according to the reaction $2H + O \rightarrow HOH$, which has been discussed previously. This reaction, together with the reaction of metal chloride reacting with sodium hydroxide, yields a metal hydroxide and sodium chloride: $MCl + NaOH \rightarrow MOH + NaCl$. The placing of some types of deposits on the higher copper content alloys may result in the formation pits, yet, on the other hand, the same deposits on the lower copper content alloys may result in the formation of areas of localized dezincification, i.e., a plug of copper forms instead of a pit.

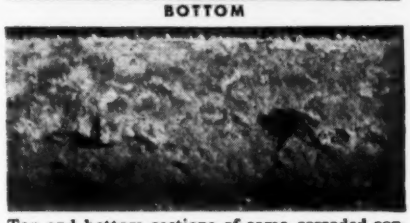
The localizing of the corrosion is due to the fact that differences in electrical potential exist between the areas having thicker films or deposits and the areas having thinner films. This type of corrosion is electrolytic and takes place in a manner similar to the galvanic cell. A familiar example of the galvanic reaction is the dry cell found in flashlights which functions because there is an electrical difference between zinc and carbon submerged in the same solution (electrolyte). The anodic zinc pole (negative) of the dry cell corresponds to the areas of concentrated corrosion; the cathodic carbon pole (positive) corresponds to the slightly corroded areas; the sal ammoniac solution corresponds to the water or salt solutions (weak electrolytes); and the depolarizing agent manganese dioxide corresponds to the dissolved oxygen in the water or salt solution.

It is apparent from this discussion that clean, unpolluted circulating water is highly desirable in the maintenance of condenser tube life. Deposits of foreign matter which tend to cling to the tubes or settle in the tubes are a source of potential danger as to localized corrosion which attacks the metal in the form of destructive pits. Frequently many pits form and overlap giving the appearance of fairly uniform thinning. Generally under these conditions the more severe corrosion occurs in the bottom half of horizontal lengths of pipe and tubing at a rate of from two to five times that occurring in the upper half of the same tube. *Keeping the tubes clean will increase tube life.*

TOP



BOTTOM



Top and bottom sections of same corroded condenser tube. Debris settling on bottom responsible for localized corrosion. Black spots are holes.

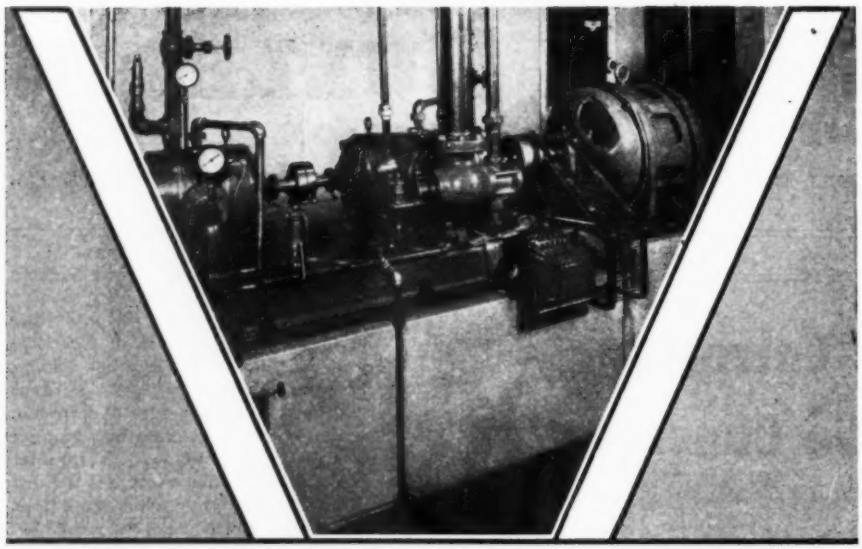
Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

BRASS

ESTABLISHED 1865



PERFORMANCE FOR VICTORY

AND PEACE-TIME PRODUCTION

Fuller Rotary Compressors are doing their part in a big way to win the victory and, after that, they'll still be on the firing line for peace-time production. They're working day and night in cement and steel plants, foundries, shipyards, alcohol, aircraft, and chemical plants, gas and oil refineries. They're built to take it and performance records prove their worth.

One plant engineer in a war industry writes: "It is now approaching the third year of continuous operation for your two-stage compressor, (1800 C.F.M., 100-lb. pressure), during which time we are glad to report that the service load factor has been in the neighborhood of 99.9 per cent."

FULLER ROTARY COMPRESSORS

Another — "Your two-stage compressor, (100 C.F.M., 80-lb. pressure), has run 23 hours per day almost continuously for four years and has given no trouble." Not a cent was spent for repairs during these four years.

In a foundry — during three years' operation only $3.90 was spent for repairs on a two-stage compressor, (330 C.F.M., 100-lb. pressure).

Performance such as this will help to gain a more speedy victory. And, after that, they'll still give you many years of efficient performance at minimum operating expense with capacities maintained for the life of the machine.

C-87

FULLER COMPANY

CATASAUQUA — PENNSYLVANIA

CHICAGO, 3 Marquette Bldg. WASHINGTON, 5, D.C. Colorado Bldg. SAN FRANCISCO, 4 Chancery Bldg.

Argument Corner

(*Continued from page 124*)

The metal is stretched in the vertical axis and thinned at termination of horizontal axis. When the boiler is started, the damaged tubes take the beating, and as the bubbles form at the surface over the fire their movement is interrupted because of the changed shape and uneven surface at the edge of the imbedded scale patch.

The last paragraph of Mr. Gorrie's article covers the subject well. From experience I know that bagging has great potentiality for destruction of life and property.

Not frequently, but too often, when an operator is told there are small bags in some tubes, he replies, "We watch them closely, wash out and put the turbine through at frequent intervals. You will find the tubes as clean as a hound's tooth the next time you inspect." The statement is made in all sincerity, but the result is the same without exception.

In one plant, slag falling about 30 ft from side walls caused the screen tubes of a pulverized-coal-fired bent-tube water-tube boiler to sag. There were flats, dents and severe stretching of a 4-in. tube. The stretch showed the bottom of the adjacent tubes, with a good margin to spare, over the top of the sagged tube. Since a straight line is the shortest distance between two points, the stretch cannot be denied. Had there been none, one or other of the tube ends would have pulled completely out of the manifold. It is also clear that there is a compressive stress in one side of the tube and a tensile stress in the other. It was difficult to convince the management that sound reasons rather than overanxiety of the inspector demanded removal of the tubes.

The sagged tubes, when opened, may not cause an explosion, but the repair bill and production loss will run to big figures. "It is the little rift within the lute, that by and by will make the music mute."

We hope that the many men who could testify to the importance of immediate attention to bagged tubes or shells are resting in peace, even though prematurely. If new tubes have been put in a boiler and one of them spilts in service, no scale or oil being present, do not delay. Send a sample of the tube to the U. S. Government office for analysis.

Buffalo, N. Y. ALON CARTER

STRETCH

YOUR PLANT'S STEAM CAPACITY

Are you racking your brain to figure safe ways of stretching the steam capacity of your present power plant equipment? There's a simple answer—safe, practical, effective: Hays Centralized Automatic Combustion Control, *"The All-Electric Way."*

These obvious benefits begin immediately when you install Hays Combustion Control:

- Automatic regulation of all combustion elements.
- Automatic measure of each variable—and instant automatic correction.
- Automatic *measure of each correction,* to maintain exact balance.
- Saves man hours—releases man power for other duties.
- Vital operating economies.

Hays Combustion Control is doing an outstanding job of increasing industry's steam capacity when that added capacity is most imperatively needed.

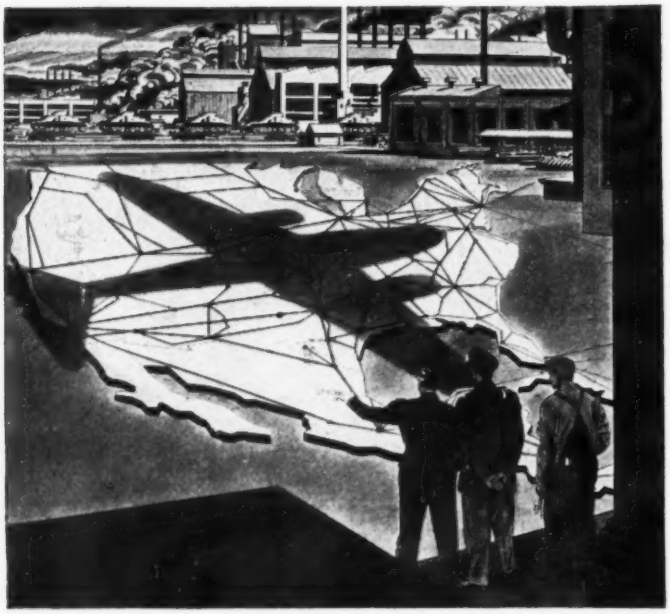
Hays Systems are individually designed to fit individual needs. Hays Combustion Control Catalog is full of useful data. Write for it.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, IND.

Get it Fast...specify AIR EXPRESS



IF you want your orders shipped *fastest way*, be sure to specify "ship AIR EXPRESS"—because general instructions such as "urgent" and "rush" may be misinterpreted by the shipper.

And it's especially important to specify AIR EXPRESS if your shipment is vital to a war job, because it saves something like 75% of the hours and days consumed over the next fastest means of shipping. This 3-mile-a-minute service is available direct to more than 350 U.S. cities and to scores of foreign countries.

AIR EXPRESS RATES REDUCED

As a result of the great volume of Air Express traffic created by wartime demands and the increased efficiency developed to satisfy these demands ...Air Express rates within the United States have been substantially reduced, in some instances as much as 12½%, depending on the weight of the shipment and the distance it moves. Consequently, shippers nationwide are now saving an average of 10½% on air cargo costs.

NOTE TO SHIPPERS: *Ship Early*—as soon as shipment is ready—to assure fastest delivery. *Pack Compactly*—to conserve valuable space.

ASK for our new 1943-44 CALENDAR-BLOTTER. Write Dept. PR-11, Railway Express Agency, 230 Park Avenue, New York 17, N. Y.

AIR EXPRESS
AIR EXPRESS
Gets there FIRST

Phone RAILWAY EXPRESS AGENCY, AIR EXPRESS DIVISION
Representing the AIRLINES of the United States

Readers' Problems

(*Continued from page 113*)

tion bolts to hold evenly and securely.

Whether anchor-guy rods imbedded in the floor will be satisfactory depends on how the job is done. If the engine is large, these anchors naturally have to be of considerable size and anchored into a solid foundation. Also, the angle they make with the horizontal determines the effect of these guy rods on the engine.

The nearer they approach the vertical, the greater their tendency to bend with engine movement. True horizontal guys connected at opposite ends of the frame and solidly anchored in bumber blocks offer the best solution if space is available for installing them.

Regardless of what is causing MC's trouble, he should correct it immediately even if he shuts down the plant. This movement is bound to carry over to the steam piping and cause leaking joints or perhaps a broken line.

New York, N. Y. L C RINEHART

Remove Faulty Foundation Material

THE CONDITION DESCRIBED could be improved by bracing or using guys, but if oscillation causes the trouble, rebuilding the defective parts is the best solution. Temporary repairs by pressure grouting would not be successful because new concrete does not bond satisfactorily to oil-saturated material, especially in thicknesses of ½ in. or less.

Best method would be to raise the engine and remove the old grout to a depth of at least one inch. If faulty material is found it should be removed until a sound surface is reached. Removal of oil-saturated surface material is essential. The engine should then be lowered to running position on wedges and regrouted in the usual way. While the foundation repairs are being made, overhaul and adjust as necessary the valves, valve gear, cylinder, piston and bearings. Faulty parts or adjustments may have been responsible for the existing condition, and a thorough check will help prevent a recurrence of the trouble. It is important that new grouting have a minimum thickness of one inch.

Saint John, N. B. C G CLARK

Each Demands Competent, Experienced Engineering

● Every plant man knows that the efficiency of an industrial operation depends greatly on getting the right material at the right place at the right time.

But extreme variations occur in these three conditions—materials, place and time—not only from industry to industry but even within a single plant. Consequently, the engineering of successful material handling systems becomes a complex matter of matching the right type of conveying equipment and accessories to each specific job.

This is a highly specialized service, but one for which Stephens-Adamson engineers are fully qualified. For S-A designs and makes ALL kinds of conveying equipment. Whether a job calls for a belt, bucket or screw conveyor—or for a combination of these types—plus whatever accessories may be required—trust the S-A representative for an unbiased recommendation as to the exact system needed to move materials faster, safer and at lower cost.

If you face the problem of modernizing or expanding existing handling equipment to meet present production demands . . . or if you are concerned over new material handling problems that will come with post-war operations . . . have a talk with an S-A engineer now. Write us today.

STEPHENS-ADAMSON MFG. CO.
5 Ridgeway Avenue - Aurora, Illinois

STEPHENS-ADAMSON MFG. CO.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

. . Fast Way to Descale and Clean Your Surface Condensers

When lime-scale or oil deposits accumulate on surface condenser tubes the inevitable result is lower operating efficiency. It clearly indicates that THOROUGH CLEANING is needed. But this does not mean a lot of trouble . . . if you use the Oakite method!

No dismantling of equipment required. Introduce recommended Oakite descaling or degreasing solution through the water or steam side of unit as directed, then rinse. Deposits are thoroughly, speedily removed. Not only is normal vacuum restored, but shutdown time is reduced as well!

NEW DIGEST FREE!

This NEW Oakite Digest describes successful ways for conserving man-hours and establishing other worthwhile economies on this and 65 other essential power plant maintenance jobs. Send for your FREE copy TODAY!

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.

Technical Service Representative Located in All Principal Cities of the United States and Canada

OAKITE *Specialized cleaning*
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

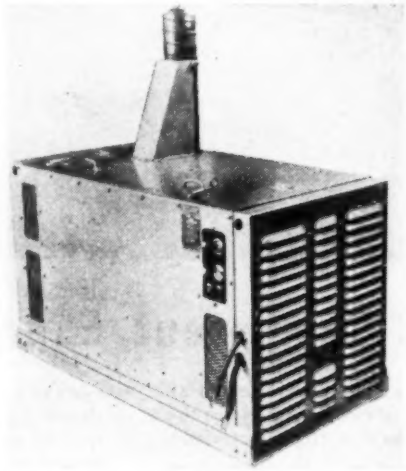
New Equipment

(*Continued from page* 126)

standard ratings from 100 to 1000 kva at 480 v and 100 to 500 kva at 208/120Y or 240 v. Can be used indoors or outdoors for power and lighting service of 600 v and below. Primary voltages from 2.4 to 15 kv can be handled. New line incorporates liquid-filled primary disconnecting switch, standard Pyranol or oil-filled transformer section, and low-voltage section with a 600-volt, easily removable air circuit breaker. Units are completely metal-enclosed, co-ordinated, factory-built substations. *General Electric Co, Schenectady, N. Y.*

Gas-Electric Power Unit

READY-POWER gas-electric Model "J" supersedes Model "G". Model "J" has smaller over-all dimensions but greater power capacity. Hinged cover at top permits quick servicing of radiator, fuel tank, battery and oil filter, while a similar front cover provides easy access to air cleaner, carburetor, fuel pump, distributor, charging generator, governor, oil filter and oil level indicator.



All engine accessories readily removable. Automatic idling obtained through patented syncotrol governor saves fuel and engine wear, according to maker. Unit consists of gasoline engine closely coupled to dc generator complete with all accessories mounted in steel housing for fastening to truck chassis. Drive is particularly adapted to powering heavy-duty trucks. *The Ready-Power Co, 3826 Grand River Ave, Detroit, Mich.*

Humidifier

SKILBECK E-120 industrial humidifier

SIMPLY PEELING laminations from Laminum shims provides the precision required in the assembly of vital aircraft parts. And the Laminum shim provides repeated quick, accurate adjustments out in the field!

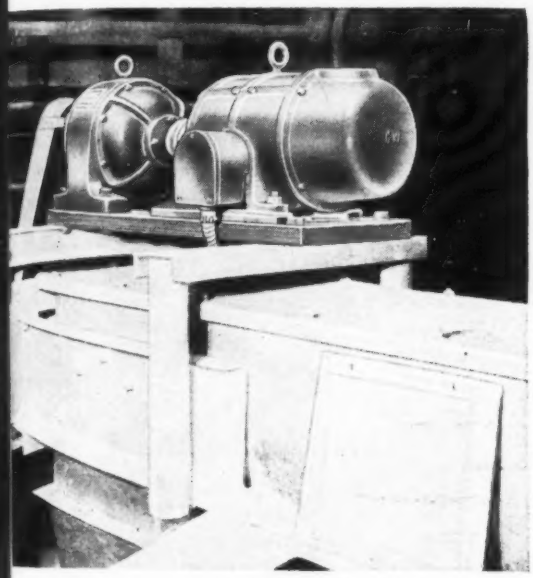
Shims cut to your specifications. Stock shim materials obtainable from your dealer. Write us for further information and shim application chart.

Laminated Shim Company
Incorporated
61 Union Street • Glenbrook, Conn.

LAMINUM SHIM STOCK
THE SOLID SHIM THAT peels FOR ADJUSTMENT

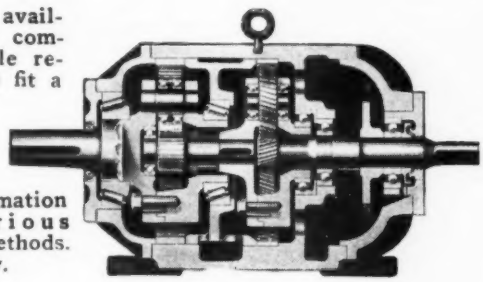
Why IS THE PHILADELPHIA PLANETARY REDUCER THE *RIGHT CHOICE* FOR A STRAIGHT LINE DRIVE?

The principle of the Planetary design was proved efficient, dependable and highly practical by Philadelphia MotoReduceRs. Those complete motor and speed reducer drive units employed the planetary construction. So well have they performed in the past dozen years that a demand was created for the same type of reducer for use where a separate speed reduction unit was indicated. This demand is being met by the Philadelphia Planetary Reducer which embodies the same features, parts and precision manufacture as the MotoReduceR.



Philadelphia Planetary Speed Reducers are compact in design yet rugged in construction. Input and output shafts are in line.

These units are available in single, compound and double reduction types to fit a variety of needs.

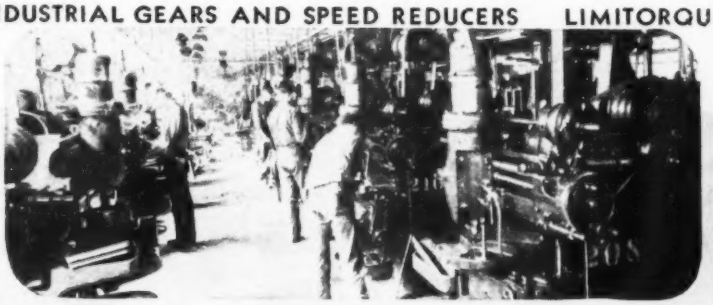


Our catalog 100 gives more complete information and shows various mounting methods. Write for a copy.

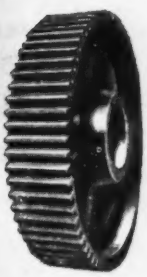
PHILADELPHIA GEAR WORKS, INC.

INDUSTRIAL GEARS AND SPEED REDUCERS LIMITORQUE VALVE CONTROLS

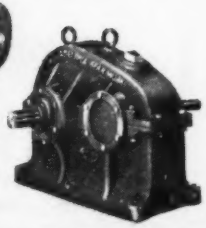
ERIE AVENUE & G STREET
PHILADELPHIA 34, PENNA.
NEW YORK, PITTSBURGH, CHICAGO



Philadelphia **LIMITORQUE CONTROL** operates all types of valves, etc., safely, economically, from convenient stations.



Philadelphia **GEARS** All types and sizes of industrial gears. Can be supplied in all materials.



Philadelphia **HERRINGBONE SPEED REDUCER** for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

Philadelphia **MOTOREDUCER** The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

Philadelphia **WORM GEAR SPEED REDUCER** right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

Silent SERVANTS to your BOILERS

HENSZEY

BOILER FEED REGULATORS

control boiler water levels continuously and accurately under all load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary—nothing to get out of order—nothing to rust.

Made for pressures up to 600 lbs. and in sizes up to 4 inches.

Send for latest Bulletin containing full details.

HENSZEY COMPANY, Dept. D10—Watertown, Wis.

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers

Feed Water Meters • Flow Indicators • Proportioning Valves

capable of dispensing 120 gal of water in 24 hr. Unit is 10 in. long and 3 in. in diameter. Can be installed in single units, or in clusters of 2 to 10 or more, allowing for humidification of unlimited space to meet area requirements. Surplus condensate accumulating in humidifier can be drained back into steam riser against pressure, or into a vacuum return line through a vacuum trap. Adjustment screw permits adjustment to obtain relative humidity desired. Drain pipe with water seal keeps unit free of accumulation of condensate. *Techmann Industries, Inc, 828 N Broadway, Milwaukee, 2, Wis.*

Pressure Switch

MICRO PRESSURE SWITCH is for proportioning control of motor-operated valves, power units, etc, for the regulation of steam, air and gas pressures. Unit is a single-pole double-throw 3-wire instrument with positioning solenoid. Pressure sensitive mechanism is mounted on a Bakelite sub-base and is enclosed in a metal case for surface mounting. Built-in condenser protects contacts. Convenient external adjustment is provided, but setting may be locked in place by means of internal locking screws. *Barber-Colman Co, Rockford, Ill.*

Floor Cleaner

OIL AND GREASE absorbent and floor cleaner, granular in form, said to be non-abrasive and not harmful to machinery or working parts. Odorless, non-poisonous and non-injurious to skin, clothing or flooring according to manufacturer. Can be spread by hand and used on many floor surfaces. Product absorbs up to 45–50% of oil or grease

RIDING ROUGHSHOD OVER NAZI WOLFPACKS

A caravan of ships . . . fat and heavy with cargo . . . plows along steadily, relentlessly. All around it, sleek escort ships race hither and yon, like bird dogs, sniffing every wave for enemy U-boats. Perhaps a wolfpack will attack. Maybe it will tag a few of these sturdy freighters. But it will pay dearly. And for every ship the subs manage to sink, American industry sends **many more* out to take its place.

One of the factors that is putting an end to the Axis submarine menace is the overwhelming numerical weight of the ships we are sending to sea. To achieve such a stupendous output, American industry has revolutionized shipbuilding methods . . . is speeding ship repair at a record-breaking pace.

It's one of the great accomplishments of the war, this success in our shipping program. And it is typical of the endless string of victories . . . all along our production lines . . . that mark the effort of American industry to help win unconditional surrender—and quickly!

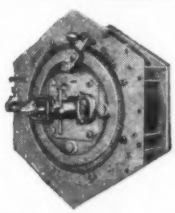
**NOTE TO THE ENEMY—Wouldn't you like to know how many?*

TODD SHIPYARDS CORPORATION

TODD COMBUSTION DIVISION

601 West 26th Street, New York City

NEW YORK · MOBILE · NEW ORLEANS · GALVESTON
SEATTLE · BUENOS AIRES · LONDON

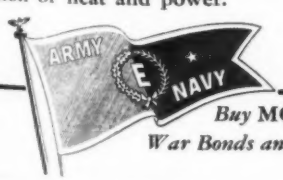


IN SHIPS OF ALL TYPES

TODD BURNERS

ARE WORKING FOR VICTORY

In countless ships, merchant and fighting, and in war plants of all types . . . wherever trouble-free, dependable combustion is a necessity . . . Todd Burners are delivering unsurpassed performance in the production of heat and power.



Buy MORE
War Bonds and Stamps

TODD BURNERS ★ ★ ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

Dart Unions

AREN'T dipped in the Fountain of Youth...

...but Your Old Darts WILL Give "Good as New" Performance

There is nothing mythical about a Dart's long life . . . nor in the fact that no matter *how much* service a Dart Union has already given, it can still supply "Tight-Joint" performance back on the job.

The *real* reasons that Darts are famous for their extra dividends in life and service are found in the way they are designed . . . and what they are made of. To be specific: Darts have matched bronze seats, ground to "true-ball" surfaces . . . and Dart Nuts and Bodies are made of High Test Air Refined Malleable Iron that resists corrosion, pipe strains and rough handling.

Even though you have already authorized one or *several* searches around your plant for used Darts to put back to work, it will pay you to make *another*. And see your supplier for *new* Darts.

DART UNIONS

E M DART MFG. CO., PROVIDENCE, R. I.

by weight, maker says. Product is being introduced in 50-lb bags. *Fidelity Chemical Products Corp, 45 Riverside Ave, Newark, N. J.*

Thermoplastic Coating

ADDITIONAL DEVELOPMENT in thermoplastic coatings for application on metal, concrete or wood. Amercoat No. 33 is a liquid plastic which is applied by conventional spray or brush methods. Manufacturer states that product has advantage that it may be applied in any number of coats required for particular condition or use. *American Pipe & Construction Co, P O Box 3428, Terminal Annex, Los Angeles, Calif.*

Outdoor ac Welder

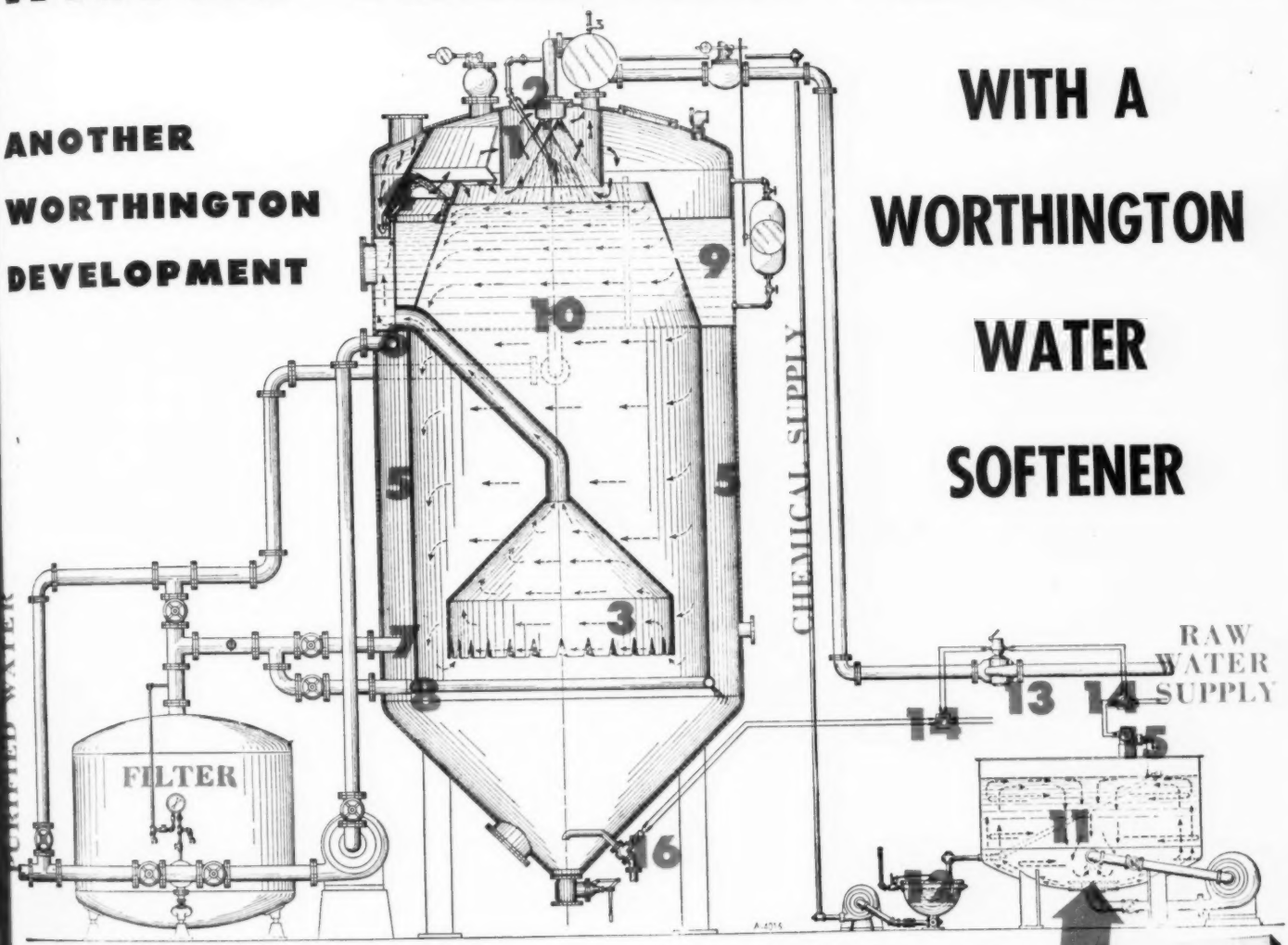
OUTDOOR AC WELDER 500-ampere has a welding current range from 100 to 625 amp at 50 volts, and is designed for outdoor locations. "Idlematic" control automatically reduces output voltage to less than 35 volts whenever the arc is not in operation, but provides full power for welding the instant arc is struck. Control also includes a switch operated by a handle extending through

the top of the case for starting or stopping the welder manually. Welder is protected against rain, snow and sleet by drip-proof construction of air openings in the top of the case and by a sealed window over the current indicator. Wide louvers serve not only to shed water but to keep air velocity low. All internal parts have a special finish for protection against corrosion from moist air. *General Electric Co, Schenectady, N. Y.*

MAINTAIN *Uniform* WATER TREATING RESULTS

ANOTHER WORTHINGTON DEVELOPMENT

WITH A WORTHINGTON WATER SOFTENER



Check these features!

1. Primary Heater. Non-scaling. Efficiently heats the raw water and provides rotary mixing of water and chemicals.
2. Chemical Applicator. Removable. Sprays chemical through steam. Facilitates mixing and reaction.
3. Up-take Cone. Baffled serrations assure even draught. Increases softener capacity.
4. Deaerating Heater. Simple. Effective. Self-adjusting. No moving parts.
5. Wash Water Compartment. Backwashing operation separate from softening process. Disturbance of softening process by filter washing operation is avoided, permitting *uniformly* continuous operation.
6. Supply to Filter Wash Pump Suction.
7. Discharge of Dirt Laden Wash Water. Reclaimed by settling clear within 1½ hours.
8. Cleansing Ring. Provides uniform distribution of jets for washing softener precipitate and wash water sediment to central area of conical bottom.
9. Storage for Treated and Deaerated Water.
10. Treated and Deaerated Water Outlet to filters or direct to boiler feed pumps.
11. Chemical Agitator. (See above at right).
12. Chemical Dilution and Pump Suction Tank.

NOTE THE EXCLUSIVE CHEMICAL SUPPLY AGITATING SYSTEM

Circulation of liquid chemical supply through *stationary* diffuser maintains uniform chemical strength without use of moving parts within tank.

The value of this superior feature is indicated by the *uniform* quality of the treated water.

13. Proportioning Meter. Accurate. Low loss. Equipped with totalizing register.
14. Relays. Adjustable time interval.
15. Decanting Mechanism. Sturdy. Reliable. Accurate.
16. Sludge Remover. Removes sludge in proportion to its rate of formation.

For full details Bulletin W-212-B2 is available at district offices (in all principal cities) or at headquarters.

WS3-1

WORTHINGTON

WORTHINGTON PUMP & MACHINERY CORPORATION • GENERAL OFFICES: HARRISON, N. J.

Don't

YOU NEED A PRIORITY FOR SANTOSITE

to protect your boilers against OXYGEN CORROSION

MONSANTO SANTOSITE, the sure and economical treatment to remove dissolved oxygen from boiler feed water, is plentiful again. And, we are confident, there will be an abundant supply from now on.

Through years of experience, power plant operators have found that 30 parts of Santosite per million parts of water give ample protection against dangerous oxygen corrosion. And it gives this protection at remarkably low cost. Santosite, an anhydrous crystalline product, is easy to handle, store and apply.

Your request for complete details on the application of Santosite to your boiler feed water, will get prompt attention. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, St. Louis, Missouri.
District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal, Toronto.

MONSANTO CHEMICALS
SERVING INDUSTRY...WHICH SERVES MANKIND

"E" FOR EXCELLENCE—The Army-Navy "E" burgee with two stars, "representing recognition by the Army and the Navy of especially meritorious production of war materials" over a two-year period, flies over Monsanto's executive offices in St. Louis and over Monsanto plants at Anniston, Ala., and Monsanto, Tenn. The Army-Navy Production Award also has been won by five Monsanto plants at St. Louis, Mo., Monsanto, Ill., Karnack, Texas, and Springfield, Mass.

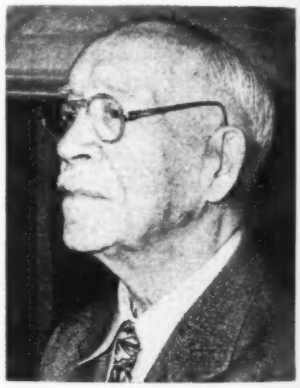
Power Lines

(*Continued from page 130*)

Stephen C Casteel; National Vice President C A Bland; and National Secretary Fred Raven.

In addition to many reports and discussions, Philip L Burger, War Manpower Commission, lectured on "Training Within Industry." Dr F N Alquist, Dow Chemical Co, explained the use of Xray and spectroscope for high-speed analysis of boiler scale and its removal by modern chemical methods. Subjects discussed in business sessions included engineers' license laws and educational methods.

At the last session Clyde A Bland, Des Moines, Iowa, automatically resigned from the vice presidency to the presidency. Warren D Lewis, chief engineer, Hotel New Yorker, New York City, was elected vice president and thus placed in line for the presidency next year. Fred W Raven, veteran national secretary of the association, was retired on pension after many years of faithful service. Secretary elect is A F Thompson, of Buffalo.

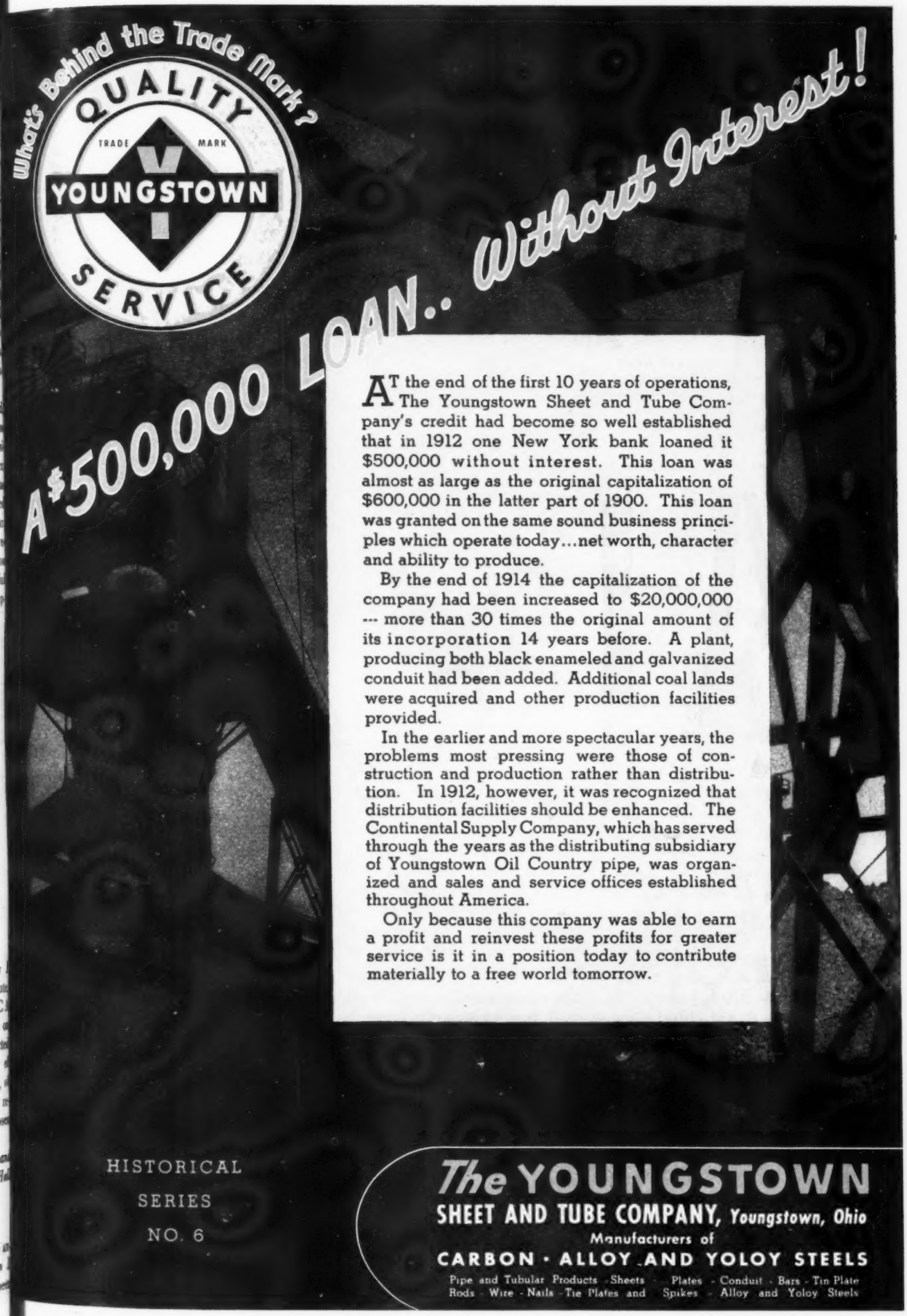


F W Raven, retiring secretary

Reelected officers include Harry A. Harp, treasurer, and Thos J Gambatese, chairman of the board of trustees. C. A. Nelson and T R Herlihy continued on the board of trustees. Newly elected trustees are Clifton R Harding, of Kittery, Maine, and John J Reddy, of Jersey City, N. J. E F Dillion was re-elected conductor. St. Louis was chosen as the next convention city.

Photos of Messrs Bland, Lewis and Raven courtesy of Alfred Watson, Hall Laboratories, Inc.

Westinghouse Electric & Mfg Co announces two appointments: **John A. Nielsen,** application engineer, has been



AT the end of the first 10 years of operations, The Youngstown Sheet and Tube Company's credit had become so well established that in 1912 one New York bank loaned it $500,000 without interest. This loan was almost as large as the original capitalization of $600,000 in the latter part of 1900. This loan was granted on the same sound business principles which operate today...net worth, character and ability to produce.

By the end of 1914 the capitalization of the company had been increased to $20,000,000 --- more than 30 times the original amount of its incorporation 14 years before. A plant, producing both black enameled and galvanized conduit had been added. Additional coal lands were acquired and other production facilities provided.

In the earlier and more spectacular years, the problems most pressing were those of construction and production rather than distribution. In 1912, however, it was recognized that distribution facilities should be enhanced. The Continental Supply Company, which has served through the years as the distributing subsidiary of Youngstown Oil Country pipe, was organized and sales and service offices established throughout America.

Only because this company was able to earn a profit and reinvest these profits for greater service is it in a position today to contribute materially to a free world tomorrow.

HISTORICAL
SERIES
NO. 6

The YOUNGSTOWN
SHEET AND TUBE COMPANY, Youngstown, Ohio
Manufacturers of
CARBON · ALLOY AND YOLOY STEELS
Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate
Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels

Hot Liquor Storage Tank being insulated sides and bottom with B-H Mono-Block, covered with a scratch coat one-half B-H No. 1 Cement, one-half Asbestos Cement.

When you put on the heat
B-H MONO-BLOCK
Can Take It

You can't beat Baldwin-Hill Mono-Block Insulation for performance when it comes to boilers, engines, ovens, furnaces, and other high-temperature installations. Here is a felted block insulation that is effective over the entire temperature range up to 1700° F. in contrast with most other molded type insulation blocks that are made for either high or normal temperatures—not both.

B-H Mono-Block is felted by a patented process from *black* rock-wool that refuses to break down under much greater heat than many other types of insulation can stand. It is moisture-resistant and will not disintegrate under humid conditions. Being exceptionally low in conductivity, it does a better job of saving steam costs.

B-H Mono-Block is easy to install. It is sufficiently rigid to support its own weight, and yet yielding enough to absorb surface irregularities. Send for full information and generous sample.

BALDWIN-HILL INSULATIONS

BALDWIN-HILL COMPANY

575 KLAGG AVE. • TRENTON 2, N. J.

NEW YORK, N. Y. • CHICAGO, ILL. • HUNTINGTON, IND. • KALAMAZOO, MICH.

named plastics specialist for the Los Angeles area. He has served the company since 1929. **Ralph C Stuart** has been appointed manager of the lamp division, with headquarters in Bloomfield, N. J. He has been with the company 25 years. He will have charge of lamp division sales, illumination engineering, as well as manufacturing and engineering in the division's plants.

Francis O Clukies has joined the sales staff of **Robins Conveyors, Inc.** He will specialize in products of the Mead-Morrison division. He was with Mead-Morrison Mfg Co some 30 years before Robins bought the materials-handling end of that company. . . . **The Lincoln Electric Co** announces the appointment of **H E Cable,** welding engineer as representative in the Pittsburgh territory. He will assist **W R Persons,** Pittsburgh district manager. . . . Appointment of **Richard W Murray** as brush engineering representative for the Conn. and Rhode Island territory has been announced by **The Osborn Mfg Co.** . . . **E K Burgess** has been appointed assistant sales manager, **Briggs Clarifier Co.**

Patron Transmission Co, New York City, announces their appointment as exclusive authorized distributor in the metropolitan area of **Lewellen Mfg Co,** of Columbus, Ind., mfgrs of variable-speed transmissions and motor pulleys.

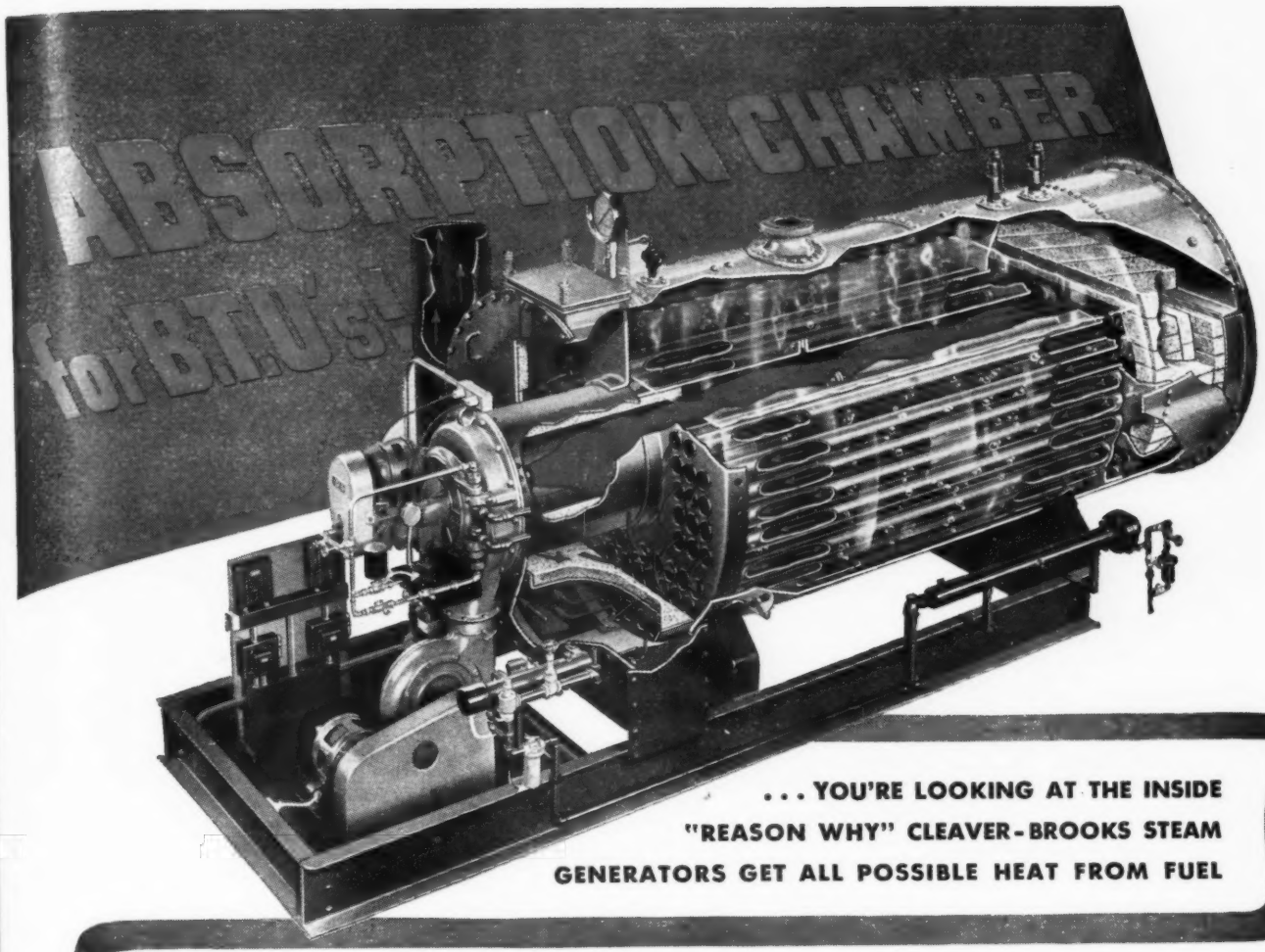
EMERGENCY SPECIFICATIONS FOR FIRE EXTINGUISHERS

Practically the entire output of critical metals for new fire extinguishers is going to the armed forces and to war plants with top priority ratings. In many cases, damaged or obsolete standard fire extinguishers cannot be replaced until after the war.

To relieve the situation, Underwriters' Laboratories, Inc, and the Factory Mutual Laboratories, which test and permit labels of approval on various types of extinguishers meeting their standards of design and performance, have adopted *emergency alternate specifications.* The following statement of Underwriters' Laboratories, Inc, expresses the spirit in which these specifications have been adopted:

"National preparedness and defense and now wartime controls of critical materials, have required use of various substitute materials and methods, some of which may not be acceptable after Victory, their replacement becoming a necessary part of the cost of war."

However, proper care of standard fire



. . . YOU'RE LOOKING AT THE INSIDE "REASON WHY" CLEAVER-BROOKS STEAM GENERATORS GET ALL POSSIBLE HEAT FROM FUEL

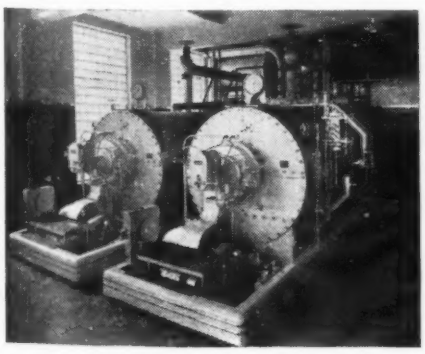
The basic reason for the high thermal efficiency and low fuel costs of Cleaver-Brooks Steam Generators is graphically shown above.

The remarkable thermal efficiency of more than 80% of a Cleaver-Brooks Steam Generator is accomplished by the original and exclusive Cleaver-Brooks four-pass, down-draft construction of the boiler.

Note the four complete passes of combustion gas travel through the entire tube length of the boiler proper, with the fourth and last pass at the bottom, assuring equalized stress over the entire shell surface.

It is these extra economizer passes which enable the boiler to absorb the greatest practicable amount of heat from the fuel burned. With a Cleaver-Brooks Steam Generator exhaust temperature is only 125° above that of steam and water in the boiler; CO_2 analysis is not less than 14%.

Quick steaming capacity — minimum man-power needed for operation and maintenance — cleanliness, no smoke, ashes, clinkers — compact, space-saving design — simple, low-cost installation — dependable performance — these are all added advantages of a Cleaver-Brooks Steam Generator.



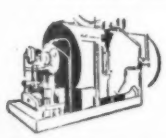
Showing two 300 HP. Cleaver-Brooks Steam Generators as installed at the Downing Box Co., Milwaukee. Note compactness and entire absence of breeching and feed-water piping — all piping concealed in pits below floor level.

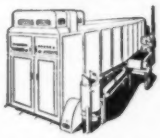
Get complete information now—for the future — on Cleaver-Brooks Steam Generators — sizes 20 to 500 HP.; pressures 15 to 200 lbs.

CLEAVER-BROOKS COMPANY
5109 North 33rd Street **Milwaukee 9, Wisconsin**

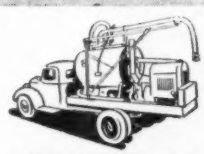
Cleaver-Brooks
STEAM GENERATORS

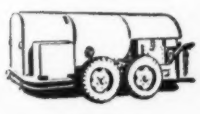
CLEAVER-BROOKS PRODUCTS INCLUDE:

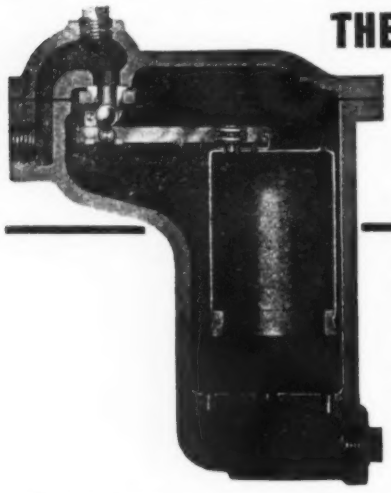

Steam Generators


Food Dehydrators

Tank Car Heaters


Bituminous Boosters


Special Military Equipment



THE WAR LOAD IS HEAVY—
CRYER TRAPS WILL HELP YOU CARRY IT!...

Maximum service from your steam lines is a "must" today. Air binding, slow venting and dribbling traps or traps demanding frequent attention by a maintenance staff already short of manpower are handicaps to be avoided. That's why it will pay you to investigate the trouble preventing, steam saving and maintenance reducing advantages assured by CRYER STEAM TRAPS.

These features assure effective performance

Sizes: ½" to 2½"
Capacities: 500 to 38,000 lbs. of water at pressures from 0 to 250 lbs

We carry all sizes of traps and repair parts for the line formerly known as the J-M Ball Steam Trap.

Accessibility—all mechanism easily removed without disconnecting piping.
Positive Action—correct seating insured by a free turning ball.
Quick Venting—air quickly discharged through a mechanically controlled quick venting valve.
Non-Binding — air completely discharged **before** condensate through valve at top.
Long-Life and Low Maintenance—all parts designed for maximum service and accessibility.
Easy to Install—no special supports required, connections easily made.
Guaranteed for Performance—will operate satisfactorily at rated capacities within limits of pressure or MONEY BACK.

CRYER TRAP & VALVE CO., INC.

Manufacturers of Steam Specialties for over 40 years.

366 MADISON AVE. **NEW YORK, N. Y.**

"IT'S TOPS!"

THE VIKING HEAVY DUTY PUMP

Rugged construction and simple design, with no complicated or intricate parts, make this Viking Pump just the sturdy and dependable pump you need for heavy duty service. Every part is constructed to stand up under long, hard service. It's there to "take it", no matter how tough the going.

Send for our new Bulletin 2900. It gives you complete specifications and full illustrated data on the Viking Heavy Duty Pump. Write today. IT'S FREE.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA

extinguishers that conform to the underwriters' peacetime standards will keep them in good operating condition indefinitely. Enforcement of the following general rules prolongs the usefulness of existing equipment:

1. Recharge extinguishers immediately after use and after the interval of time recommended by the manufacturer.

2. Use only recharging supplies and replacement parts obtained from the manufacturer.

3. Follow instructions on units closely when recharging all types of extinguishers.

4. Inspect extinguishers at least once a month to make certain they are filled, operative, and have not been tampered with.

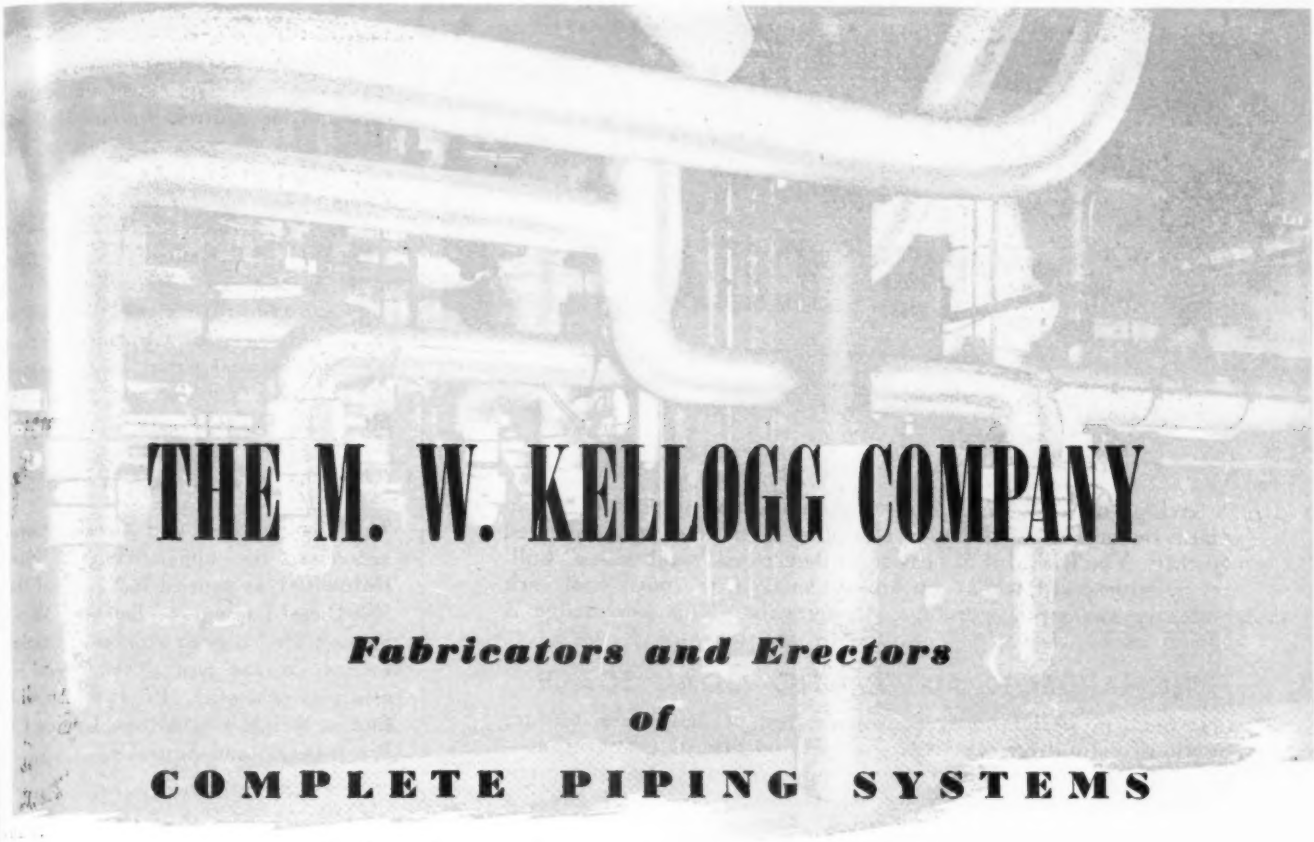
5. If an extinguisher is damaged by a blow or fall so that there is a possibility that the shell or seam has been damaged, have the extinguisher tested by the manufacturer or his agent.

6. Do not attempt repairs of damaged extinguishers. Return them to the manufacturer for the skilled work such service demands.

7. Have men on the premises who are familiar with the inspection and recharging of extinguishers, and who understand the correct methods for keeping the equipment ready for instant, efficient use.

General Electric Co announces the following appointments: **Alexander Kennedy, Jr,** assistant to the manager in charge of engineering, federal and marine divisions, and **Howard P Bish,** assistant to the manager in charge of administrative affairs. Both are newly created positions. Mr Kennedy, a graduate of Cornell, has been with the company since 1908, identified with marine affairs since 1919. Mr Bish, a graduate of Ohio State University, has been with the company since 1919. Since Feb 1942 he has been manager of sales of the federal and marine dept. **C H Linder,** has been appointed assistant manager of the Schenectady Works. After graduating from University of Texas in 1924, he entered the company. He was assistant to J M Howell, works manager, from 1942. **F T Lewis** has been appointed assistant to J M Howell. He entered the employ of the company in 1916; since 1940 has been production manager at the West Lynn Works.

The Timken Roller Bearing Co announces two appointments: **W H Richardson** as general manager on the West



THE M. W. KELLOGG COMPANY

Fabricators and Erectors

of

COMPLETE PIPING SYSTEMS

for

HIGH PRESSURE — HIGH TEMPERATURE
PUBLIC UTILITY and MARINE POWER PLANTS

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PROCESS PIPING FOR INDUSTRY

Heat Transfer Equipment for Industrial and Marine Power Plants

KELLOGG

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, NEW YORK 7, N. Y.
LOS ANGELES, 609 SOUTH GRAND — REPRESENTATIVES — TULSA, PHILTOWER BLDG.

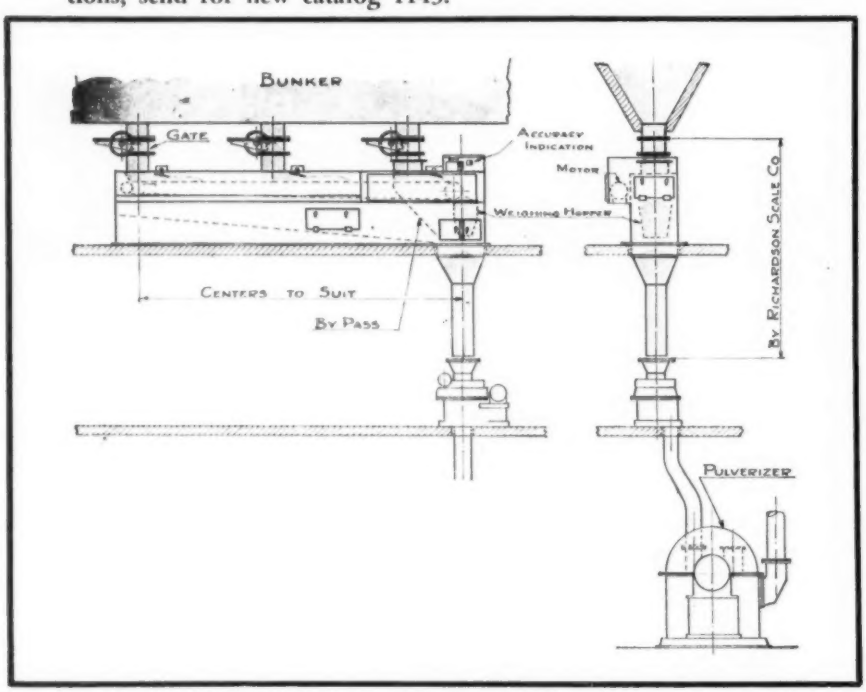
BOILERS UNDER CONSTANT TEST USE LESS COAL

Savings on coal often run to thousands of dollars yearly in plants where lowered boiler efficiency is spotted and remedied quickly. You'll find it far easier to detect the "weak sister" boilers in your plant when you know exactly how much coal each boiler is consuming per hour or per shift. This knowledge is always yours with a

RICHARDSON AUTOMATIC COAL SCALE

It puts the boiler under continuous test, without fuss, fanfare or use of manpower. It gives you facts on rate of evaporation—facts you can use to keep every boiler operating at maximum attainable economy. On a weekly, monthly or annual basis, a Richardson enables you to save on the quantity of coal used, often save on the quality too.

Richardson Automatic Coal Scales operate with continuous accuracy, need no attention and are dustproof. Models are available for low headroom operation. Others are equipped with elongated conveyor feeders. For details, drawings and illustrations, send for new catalog 1143.



This collecting and weighing system increases bunker capacity by reducing dead storage, saves bunker and building height, and maintains a continuous boiler test.

RICHARDSON SCALE COMPANY

CLIFTON, NEW JERSEY

4580

Atlanta Boston Chicago Minneapolis Montreal New York
Omaha Philadelphia San Francisco Pittsburgh Toronto Wichita

Coast and in the Orient, in charge of sale and merchandising of roller bearings for original equipment in railroad cars and locomotives, automobiles and trucks, and all types of industrial machinery, as well as sale and merchandising of bearings for replacement purposes. He has been with the company since 1917. **S R Kallenbaugh** has been made West Coast district manager of the steel and tube division, with offices in Los Angeles. Until his transfer he was metallurgical service representative for the company. He is a graduate of Mt Union College, with post-graduate work in metallurgy at Ohio State.

The Rogers Diesel and Aircraft Corp. announces the appointment of **Carl Hofmeister** as general manager of the Hill Diesel Engine Co., Lansing, Mich., division. He has been with the Cummins Engine Co. the past eleven years, recently as controller. He was also with Curtiss Wright Co., Allison Engine Co, Presto-O-Lite and Stutz Co.

The Joint Fuels Conference, American Institute of Mining Engineers and American Society of Mechanical Engineers' is to be held at William Penn Hotel, Pittsburgh, Pa., October 28 and 29. Four technical sessions are scheduled: Coal Research, Mining Management, Oil and Gas, and the War Program as it pertains to fuels. "Coal Faces Post-War Adjustment," by R M Weidenhammer, Brookings Institution, and "Laboratory and Field Tests on Coal-in-Oil Fuels," by J F Barkley and L R Burdick, U. S. Bureau of Mines, and A B Hersberger, Atlantic Refining Co, are only two of the many papers on the program.

To prevent catastrophe from unforeseen disruption of winter **fuel-oil supply,** OPA is insuring emergency reserves for **public utilities** and other essential users.

Reserves may be obtained by industrial and commercial users, "1102 customers," whose storage facilities can hold more than a 30-day oil supply (based on current quarterly ration), if granting of inventory reserves will not jeopardize supply of other ration holders in that area.

In general, inventory reserve will be granted in an amount equal to the **unfilled storage capacity of facilities** to store the regular 3-months' ration, or in amount of maximum 90-day requirements, whichever is less. Largest 3-month ration issued to applicant will

GOES ON FASTER and EASIER!

REDUCES APPLICATION COST!

Here at last is a new, revolutionary, patented* process that fully capitalizes upon the natural insulation superiorities of 85% Magnesia and rewrites all present-day standards of heat insulation efficiency! Plant *Precision Molded* 85% Magnesia brings unprecedented advantages, not only in easy application, but also in light weight, low thermal conductivity, controlled uniformity, "ductile strength," and many other long-desired insulation factors! Write today for complete descriptive data.

BUY WAR BONDS and STAMPS

PLANT
PRECISION MOLDED
REG. U. S. PAT. OFF.
85% MAGNESIA
"THE DEPENDABLE STANDARD—MODERNIZED"

*U. S. Patent Nos. 2,131,374, 2,209,752, 2,209,753, 2,209,754

PLANT
RUBBER & ASBESTOS WORKS

Manufacturers of Plant Insulating Materials and Mechanical Packings Since 1920

MAIN OFFICE: SAN FRANCISCO

Sales Offices in Los Angeles, Wilmington, and Oakland, Calif.; distributors in principal cities.

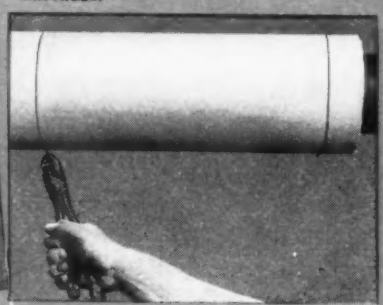
Factories in Emeryville, San Francisco, and Redwood City, Calif.

1. UNPRECEDENTED LIGHT WEIGHT! Even the larger sizes and thicknesses are easy for one man to lift!

2. CUTS EASILY and cleanly, even without canvas support, as shown here! No chipping, crumbling or "powdering."

3. BLOCKS SCORE CLEAN, TOO . . . when preparing for use as separate blocks, or when making "hinge" for application to rounded surfaces.

4. BREAKS CLEAN and straight after scoring, and thus reduces time necessary for application!



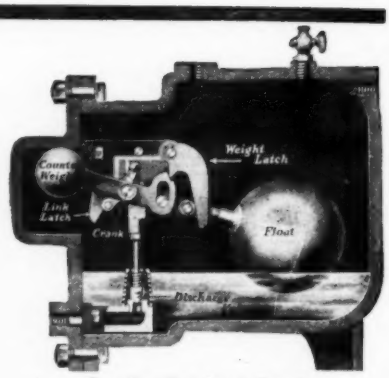
5. "RIND" SURFACE is firm yet soft enough for speedy embedding of tie wire. Because Plant *Precision Molded* 85% Magnesia is molded to exact final size and thickness, all of its surfaces are smoother. Likewise, the smooth "rind" surface and the ability of purposely-broken small pieces to hold together make for neater jobs and less cleaning-up after installation!

6. BLOCK, CROSS-SCORED, to conform to rounded surface! A new labor and time saving application-feature—made possible only by the greater "ductile strength" of this new product!

COMPLETE RANGE OF SIZES AND THICKNESSES IN BLOCKS AND PIPE COVERINGS

NICHOLSON Weight Operated Traps make sure there are no slackers on your steam lines ★ ★ ★

Positive automatic intermittent action. Large capacity. Pressures to 1500 lbs. at 1000 degree max. temp. Sturdy Design — Dependable Mechanism — not easily affected by dirt, scale, pulsation, vibration, variation in pressure, or other adverse conditions. Quick Opening and Closing Valve—no wire-drawing. Water-Sealed Discharge—impossible for steam, air or gas to escape. Hardened Stainless Steel Valves and Seats—interchangeable for all pressures. Meets ALL requirements of modern high pressure power plants.



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See Our Catalog in Sweets

W. H. NICHOLSON & CO., 125 OREGON ST., WILKES-BARRE, PA.

NICHOLSON Traps

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼ ▼ ▼

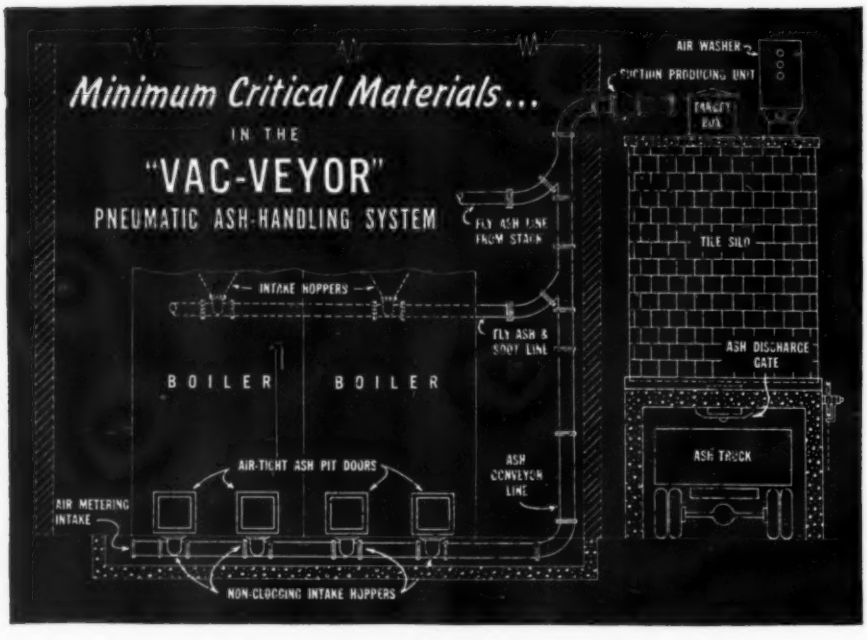
CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

Minimum Critical Materials...

IN THE

"VAC-VEYOR"

PNEUMATIC ASH-HANDLING SYSTEM



Write us today for complete details

Designed to fill today's needs in either new installations or oil-coal conversion, this pneumatic ash handling system offers numerous advantages.

BEAUMONT BIRCH COMPANY

1505 RACE STREET PHILADELPHIA, PA.

MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

determine his maximum 90-day needs.

Where winter deliveries are impossible, coupons for an inventory reserve equal to unfilled storage capacity, or twice the current quarterly ration, that is, 180-day supply based on current ration, will be granted. Consumers who get an inventory reserve are specifically prohibited from using more oil in any quarterly period than alloted them for that period.

Make applications to district OPA director. Give name and address; amount of quarterly fuel-oil ration and its use; location and total capacity of storage facilities; unfilled storage capacity on application date; amount of largest quarterly ration ever issued applicant; number and address of ration board.

Manufacturers of permitted civilian products, whose production is governed by amount of steel they receive through CMP allotments, may possibly increase their output by using excess or frozen stocks of steel available through the Steel Recovery Corp.

WPB's Consumer Durable Goods Section emphasizes that frozen or excess steel **is not available for manufacture of products banned** by various limitation orders. However, excess or frozen stocks may be used over and above CMP allotments to individual manufacturers. Excess or frozen steel may not be used to exceed scheduled production. Make application on form WPB 2757.

New publication of Stokers Mfgrs Assn, of Chicago, presents standard dimensions covering boiler and furnace firebox and base heights for stoker firing. The officially adopted recommendations carry the industry's **minimum recommended dimensions,** which it believes will go a long way, in post-war sales and installations, to assist boiler and furnace manufacturers to design and construct equipment for application to mechanical-coal-stoker firing.

Minimum inside grate dimension of 16 in. is recommended for **small round or rectangular furnaces** or boilers. **Minimum grate widths** are also covered for anthracite stokers, which are slightly larger for anthracite machines not equipped with ash-trimming apparatus.

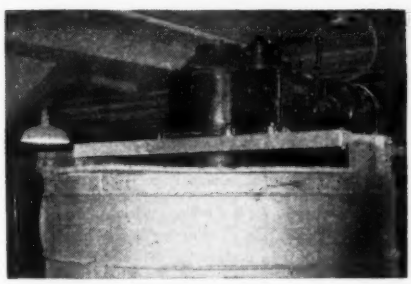
While minimum firebox dimensions are recommended for warm-air furnaces and boilers adapted to stokers with capacity up to 1200 lb of coal per hr, under certain conditions smaller fireboxes will perform satisfactorily, but dimensions suggested are **preferred normal minimums.**

Built to stand the 24 hour a day drive for victory

● Type H Heavy Duty Worm Gear Reducers driving 54-in. and 48-in. tumbling mills in steel foundry. Ratio 11-1/3 to 1 and 7-3/4 to 1.

TODAY every phase of war work calls for drives that will stay on the job. Jones Worm Gear Speed Reducers have been built for long, trouble-free service. And the records established by these speed reducers in 24 hour a day service show that they have the ruggedness and stamina for which all Jones Transmission Products are known.

For complete information on Jones Worm Gear Speed Reducers ask for Bulletin No. 68 and for Worm-Helical Reducers ask for Bulletin No. 75.



● Jones Worm-Helical Speed Reducer driving a lacquer agitator. A simple design prevents leakage of oil along the vertical low speed shaft.

RATIOS AND CAPACITIES

Jones Worm Gear Reducers are built in ratios from 4 to 1 up to 90 to 1 and in capacities from ¼ to 100 H.P.

Jones Worm Helical Reducers for vertical shaft drives are built in ratios from 40 to 1 to 250 to 1 for all common motor speeds and a wide range of horsepower ratings.

W. A. JONES FOUNDRY & MACHINE CO.
4423 Roosevelt Road, Chicago, Illinois

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES

Longer Thrift-
Shorter
War!

Many an American is stretching living allowances and buying bonds with the difference. And many an engineer is stretching the service of rugged old Ludlows so that more Ludlow production can go into vital war use. Engineering generalship suggests two ways—by properly maintaining their power systems to put idle valves to work—by renewing old, cast-off valves with replacement parts.

Ludlow Valves have always been designed for maximum endurance—so, maintenance and restoration is not unduly expensive. Ludlow will gladly undertake to furnish necessary replacement parts.

THE LUDLOW VALVE MFG. CO., INC.
TROY, NEW YORK

Construction Features: Self-releasing 30° angle wedges and free-floating gates, self-adjusting to seats, afford smooth, trouble-free performance, long service. Rings are cleaned throughout stroke action. Gates are wedge-locked directly opposite ports and completely unwedged before raising. Ample tolerances provide easy action. Simple construction permits easy replacement of parts.

V-12

LUDLOW VALVES

SINCE 1866

CURRENT ARMY-NAVY "E" AWARDS

Seven more industrial plants have received **Army-Navy "E"** pennants: **Ajax** Flexible Coupling Co, August 11; Bristol Co, July 29; Fisher Governor Co, July 14; Link-Belt Co's Pershing Road, Chicago, plant, August 20; Phelps Dodge Copper Products Corp, Los Angeles mills, August 31; Taylor Instrument Companies, recently; Warren Steam Pump Co, Inc, Sept 7.

White Star on Army-Navy "E" pennant, awarded to Kewanee Boiler Corp, August 21.

Second White Star on Army-Navy "E" pennant, awarded to Handy & Harman, recently.

Maritime "M" pennants presented to American Chain & Cable Co, Reading plant, July 16; to Wm Powell Co, recently.

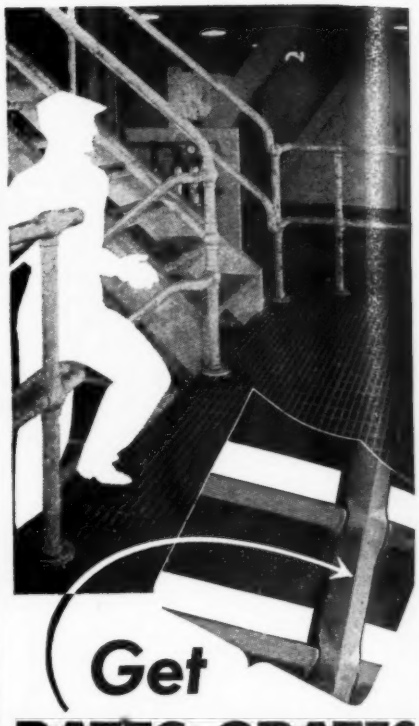
Gold Star on Maritime "M" pennant awarded to The Cooper-Bessemer Corp, recently.

OBITUARIES

Albion James Wadhams, 68, vice president and manager of the development and research division, **International Nickel Co, Inc,** died on August 22 of a heart attack. He was graduated from the U. S. Naval Academy in 1895, and saw continuous sea service for six years, including service in the Spanish-American War. He had been with International Nickel and its predecessor companies since 1901. Under his leadership many of the wide applications of nickel and its alloys have been developed. He has written many papers on history and uses of nickel.

William Finlay, 69, chief engineer, **Hayward Schuster Co,** Webster, Mass., textile manufacturers, died on August 7. Previously, Mr Finlay was an engineer for Bigelow-Hartford Carpet Co, Clinton, Mass.

John Winters Upp, former manager, switchgear division, **General Electric Co,** died at Ardmore, Pa., on August 4, following a heart attack, at the age of 75. He joined General Electric in 1901, and continued his connections with the switchgear division until he retired in 1933.

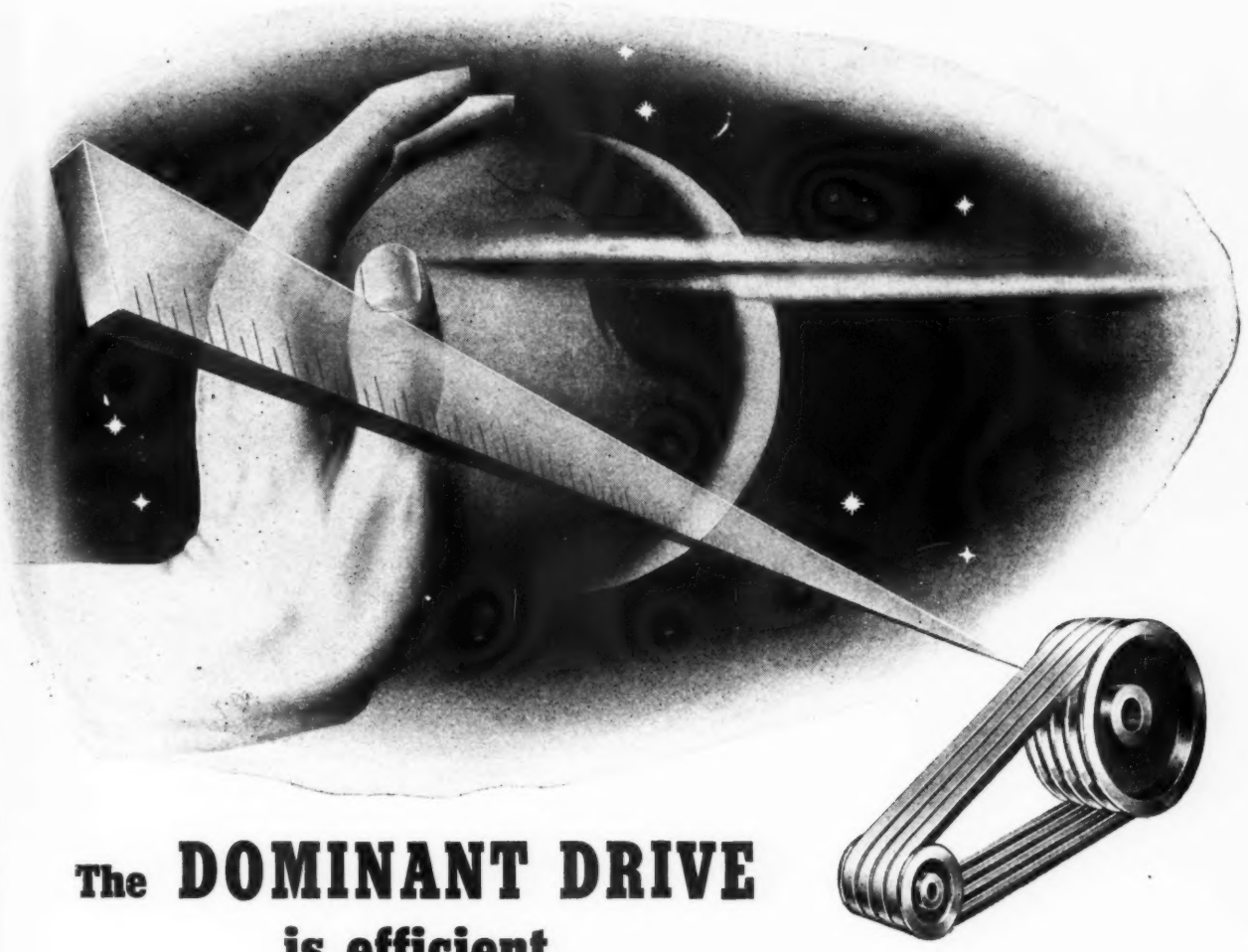


Get
BATES-GRATES
FOR YOUR OPEN STEEL FLOORING AND YOUR FLOORS, TOO, WILL BE CLEANER AND SAFER

See that scraper tread—and the crisp lines of the Hex cross bar? *That* gives a safer and cleaner tread and at the bottom of those cross bars you find clean, well-shaped fillets made by the metal displaced in the Bates patented process—no metal is lost. The weld is cleaner and stronger. The *floor* is cleaner and stronger. Yet, open steel flooring made under Bates patents costs no more.

Write for copy of well-illustrated, 8½" x 11" CATALOG NO. 43-44. It gives complete data on fillet welded Open Steel Flooring and Stair Treads.

WALTER BATES COMPANY, INC.
JOLIET • ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS



The DOMINANT DRIVE is efficient

. . . because it is Economical!

The primary yardstick in measuring the efficiency of a drive is the ratio between applied and delivered power. The higher the ratio — the more economical and therefore the more efficient. In this respect the Multiple V-Belt Drive ranks extraordinarily high. It had to, to become the Dominant Drive of Industry!

But there are other factors which combine to produce an overall economy for the Multiple V-Belt Drive which put it in a class by itself.

There's the matter of cost — original and ultimate. There's maintenance; smoothness and quietness (affecting quality and quantity of output); cleanliness, adaptability, space requirements — factors of economy in one phase or another.

To users of the Multiple V-Belt Drive, its efficiency and economy are a monument to the untiring engineering research and the pooled information obtained from countless checks and tests by members of the Multiple V-Belt Drive Association.

The use of this emblem by an association member in connection with Multiple V-Belt Drives is assurance of mechanical excellence...the result of co-operative engineering, research and experience.

MULTIPLE V-BELT DRIVE ASS'N

Trade Mark

MULTIPLE V-BELT DRIVE ASSOCIATION

140 SOUTH DEARBORN ST., CHICAGO

Here is data on

AIR and GAS CONTROL VALVES

HERE is the most complete catalog available on Blast Gates. It contains descriptions, illustrations and dimensions of slide, butterfly, wafer and Kwikleen types . . . with straight-pull, lever, handwheel and chain wheel control . . . flanged and screwed ends . . . sizes from 1 inch to 48 inch. Several charts of useful reference data are also included.

This catalog explains why ROCKWELL Blast Gates are lastingly airtight, easy to operate, assure perfect control, and have no maintenance expense . . . why they are so widely popular . . . why they provide the best blast gate investment.

MAIL COUPON FOR YOUR COPY OF THE FREE CATALOG

ROCKWELL
AIR and GAS CONTROL VALVES

W. S. ROCKWELL CO.
50 Church St., New York 7, N. Y.

Please send me copy of your Bulletin No. 402, describing Blast Gates.

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Photo courtesy of Acme News pic

WITH a hellish roar and a blaze of light this gun aboard a U.S. warship hurls a shell at an enemy raider lurking in the darkness.

Like a wounded tiger the marauder fights back viciously. But, outgunned and outfought, the attacker generally plunges to the bottom to gather slime and corrosion.

The continued successes of our all ocean Navy are understandable, however. Our ships are the best engineered—best equipped—best manned vessels on the seven seas. Their guns will continue to "Speak with Authority" until the day of "complete unconditional surrender".

Drainators are doing an outstanding job on many of these ships. Operating *continuously* on various kinds of steam using equipment—*completely* eliminating condensate and air—they aid in maintaining readiness for typically American instantaneous, spectacular and effective action.

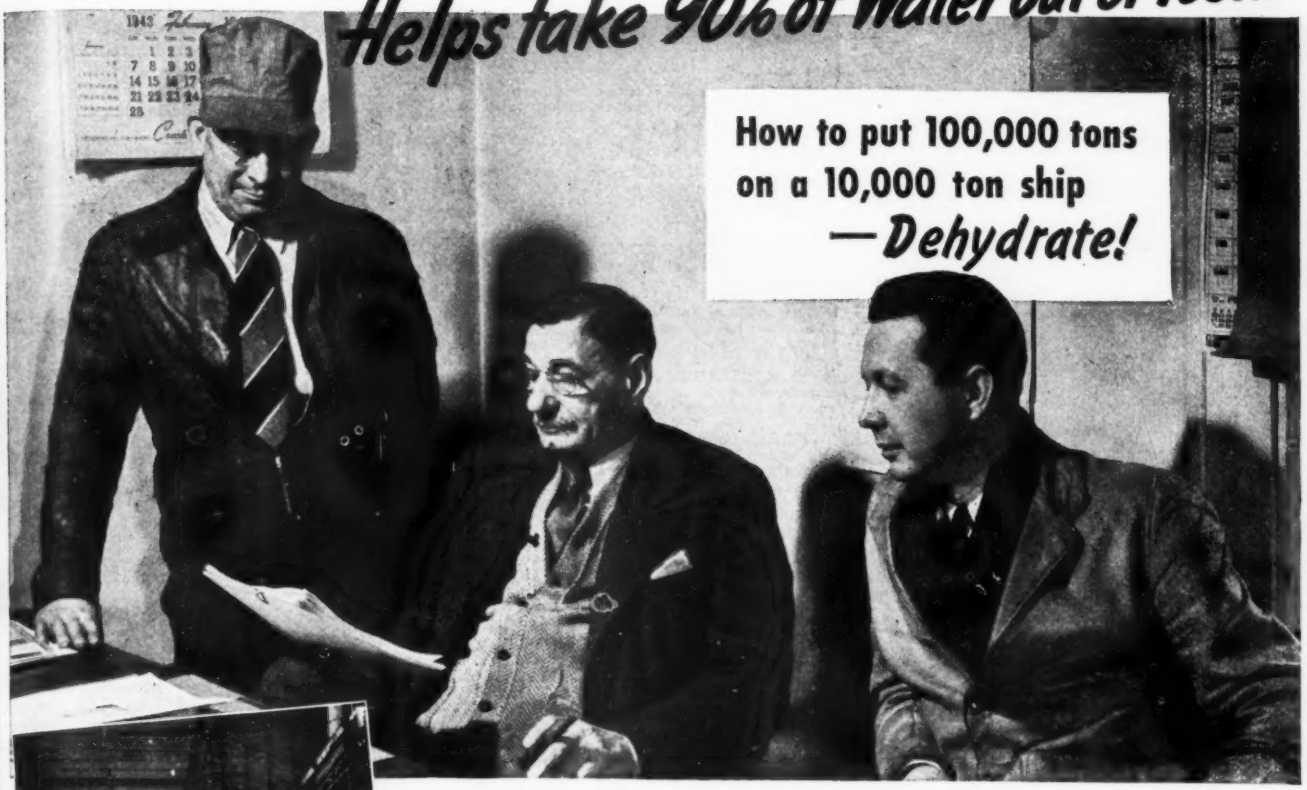
The COE MANUFACTURING Co.
PAINESVILLE, OHIO

DRAINATOR • THE ADVANCED STEAM TRAP

Write for Bulletin 903-A explaining the exclusive Drainator features responsible for exceptional service in thousands of industrial applications.

IRON FIREMAN STOKER

Helps take 90% of Water out of Foods



F. B. Huxley (*center*), owner of the largest food dehydration plant in the East, talks over plans with Superintendent Frank J. Vandewater and Manager Frank S. Haugh.

The boiler room is spic-'n'-span with this double nozzle Iron Fireman Pneumatic Spreader stoker conveying coal to the 489 horsepower Springfield Watertube boiler. When this plant was hand-fired, objectionable black smoke was produced. Now, with Iron Fireman automatic coal firing, there is no smoke nuisance.

Iron Fireman Pneumatic Spreader Stoker Speeds Production for Big New Dehydration Plant

IN a global war, the transport of food, supplies, and munitions to our soldiers and allies is a most vital problem. Nothing has done more to save cargo space and speed transport than the dehydration of foods. F. B. Huxley & Son of Ontario, New York, "de-water" cabbage, potatoes, beets and other vegetables by removing nine-tenths of their moisture content. Then the dried foods are compressed, saving more cargo space. The greatly reduced weight and bulk of the foods permits one ship to carry the equivalent of nine shiploads of the original form.

At this modern processing plant, which requires carefully controlled heating conditions for steaming and drying, it is being proved daily that fewer tons of coal can carry a heavier load, when fired automatically.

Frank J. Vandewater, the superintendent, says: "When we hand-fired, we used 20 tons of coal a day in mild weather. When we installed the Iron Fireman Pneumatic Spreader, we increased our load one-third, and yet we use only 18½ tons a day, even with temperature down to 20° below zero.

"The design of the Iron Fireman Pneumatic Spreader stoker makes it easy to operate, and very well adapted to our constant 24-hour load. The light fragmentary ash and complete absence of large, hard clinker formation is a delight to our firemen."

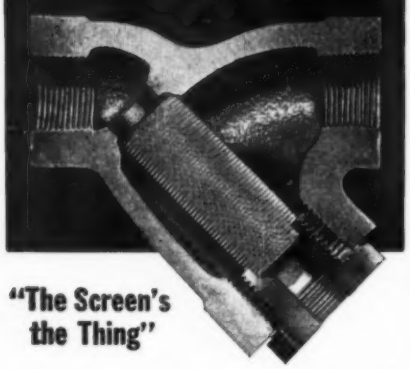
Iron Fireman Stokers Now Available

Output of Iron Fireman commercial and industrial stokers has been substantially increased to equip heating and power plants converting from oil, hand-fired coal and gas. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Co., 3507 W. 106th St., Cleveland 11, Ohio. Iron Fireman Manufacturing Co., Portland, Oregon; Cleveland; Toronto.

IRON FIREMAN THE IRON FIREMAN **AUTOMATIC COAL STOKERS**

Prevent RUST SCALE DIRT From Clogging Steam Equipment

YARWAY STRAINERS



"The Screen's the Thing"

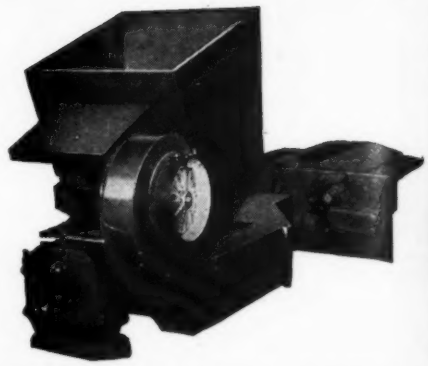
- *A High Grade Monel Woven Wire Basket* with mesh fine enough to catch the dirt—yet ample free area for passage of clean condensate, oil and other fluids.
- *Body Cadmium Plated Inside and Out for Protection Against Corrosion.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Over 100 Mill Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 Lbs.*

See Your Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY
100 Mermaid Ave. PHILADELPHIA 18, PA.

New DEVELOPMENTS BY FREDERICK ADD NEW THRIFT and CONVENIENCE TO INDUSTRIAL STOKER OPERATION

- FULL ACTIVE GRATE SURFACE . . . that's one new Frederick advantage! There's more grate area; no dead plates—whether furnished with or without side dumping grates.
- IMPROVED TUYERES are designed with air ports so arranged and proportioned as to insure thorough air distribution and maximum combustion efficiency.
- TUYERES ARE LOCKED IN PLACE so they cannot be raked up inadvertently.
- COMPLETELY INCLOSED WINDBOX simplifies and makes a neater installation; eliminates danger of efficiency loss through leaky brickwork.
- TWO CLEAN-OUT DOORS give easy access to *both* sides of the undergrate area to facilitate cleaning.



. . . All these features, and many more, are Frederick innovations engineered to give you more for your stoker dollar than has been available ever before. A complete description of these features is in our new Stoker Bulletin. Ask for your free copy. You'll find it's interesting reading.

FREDERICK STOKERS
The FREDERICK IRON & STEEL CO.
Frederick, Maryland

COMPLETE LINE OF CENTRIFUGAL PUMPS FOR ALL PURPOSES
STEAM OPERATED ASH CONVEYING SYSTEMS - ASH STORAGE BINS

NEVER RETREATS!

UNSHAKO
Reg. U. S. Pat. Off.
SELF-LOCKING NUT

A built-in, self-energizing locking ring which operates on the brake band principle keeps the "Unshako" securely in place no matter how severe the vibration, yet it can be readily removed with a wrench and used over again as often as desired. Write for catalog.

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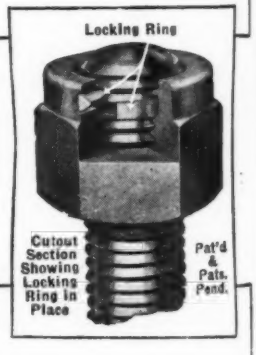

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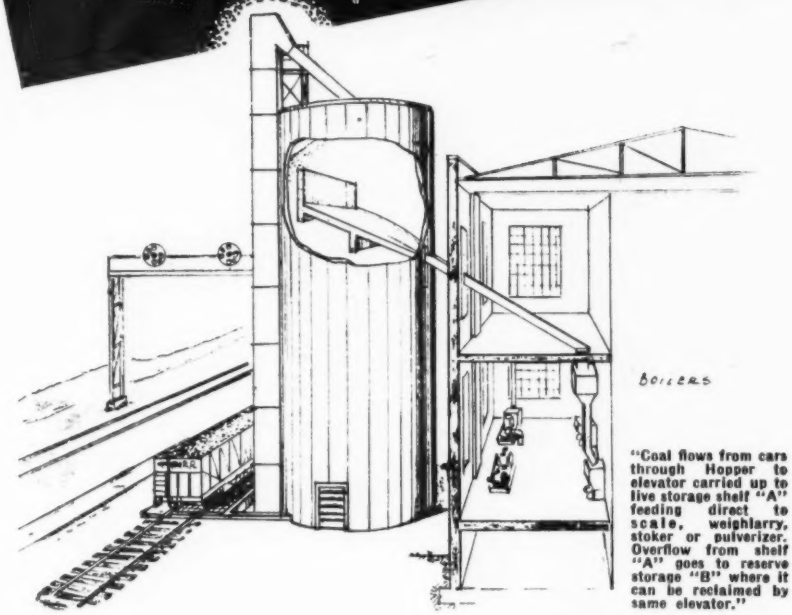

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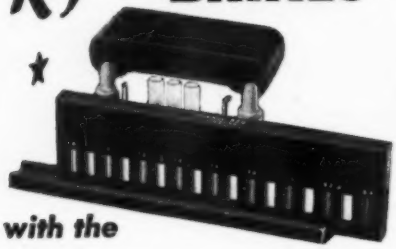

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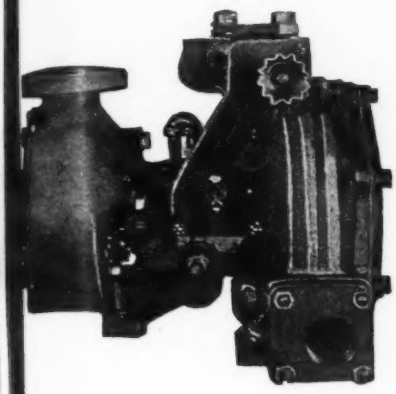

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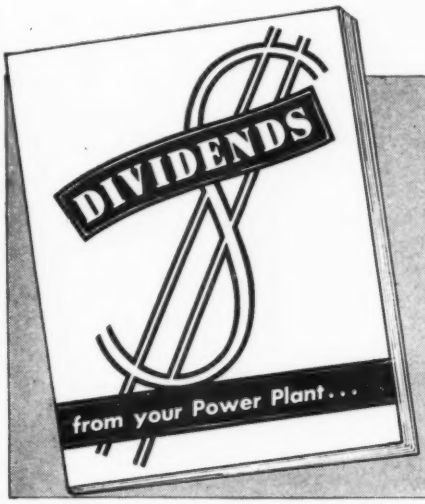

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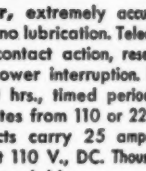

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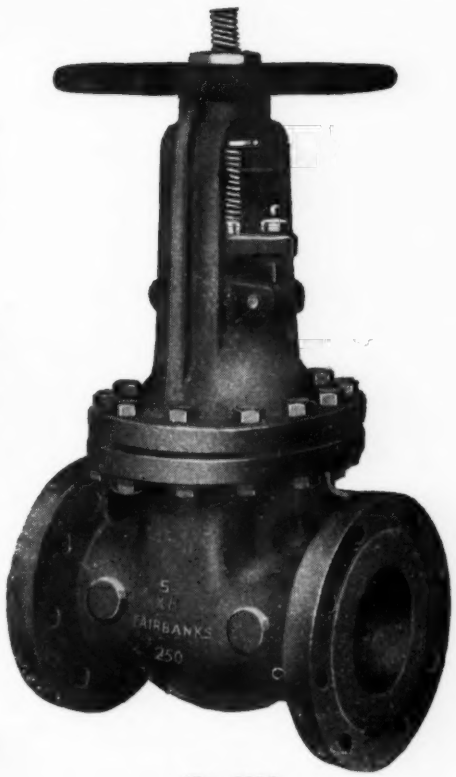

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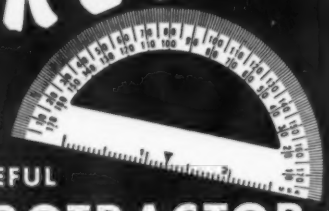

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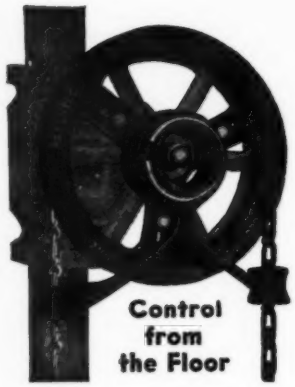

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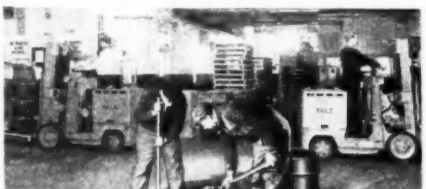

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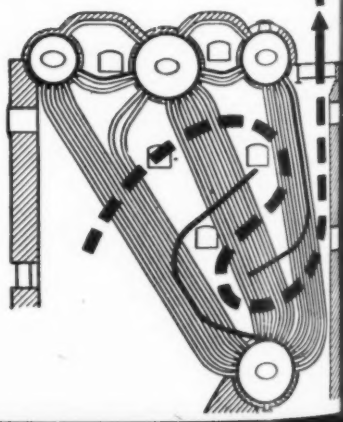

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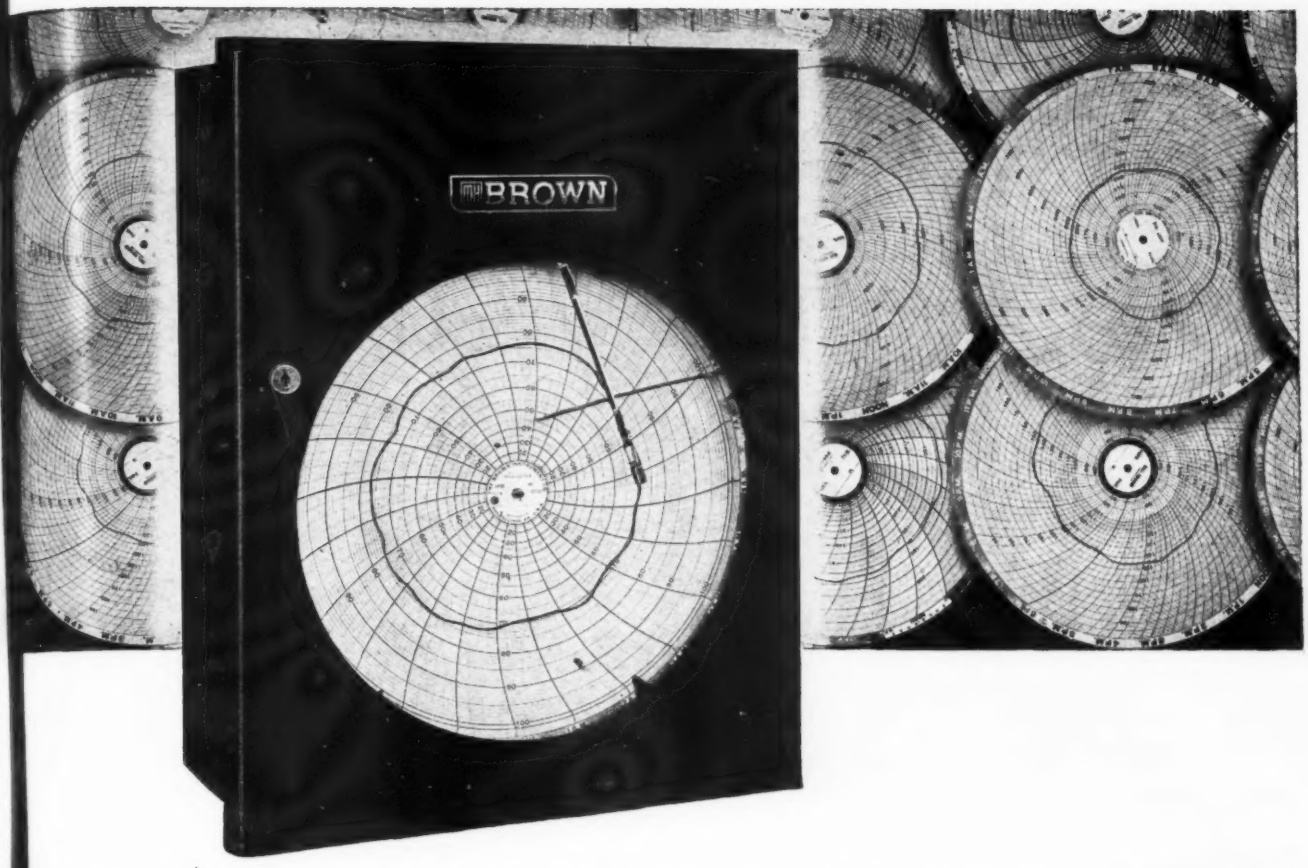

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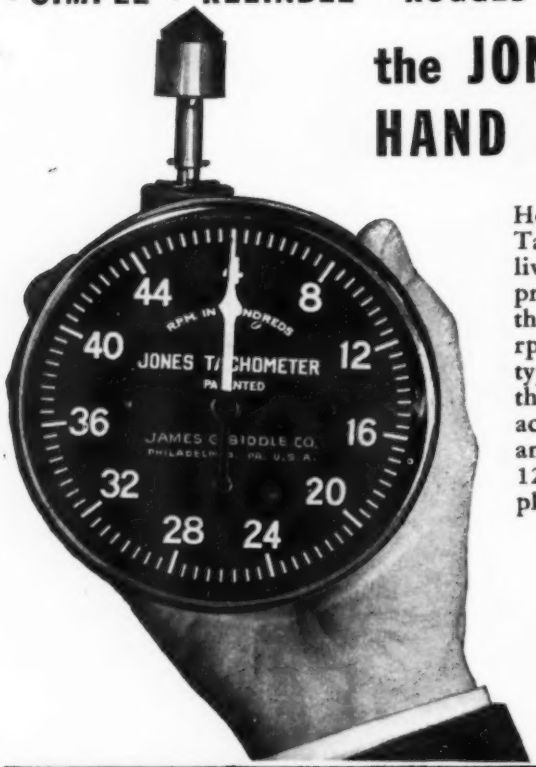

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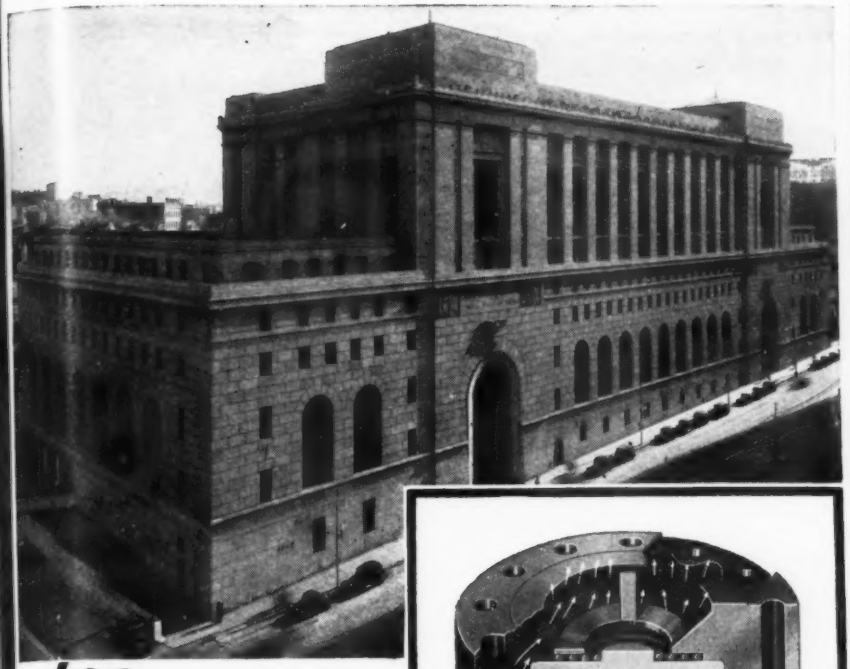

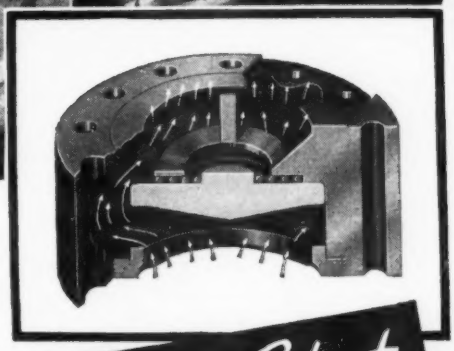

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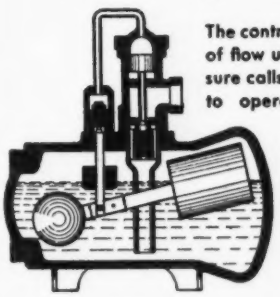
Available in iron, semi-steel, bronze, cast steel, stainless steel or monel . . . 1″ to 20″ inclusive, pressure resistant to 6000 pounds.

Write for this interesting brochure

THE WILLIAMS GAUGE COMPANY

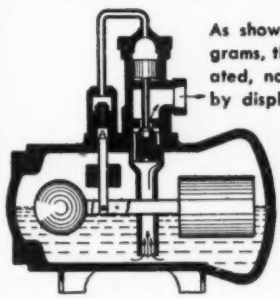
Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

How to Handle Condensate Drainage at High Pressures

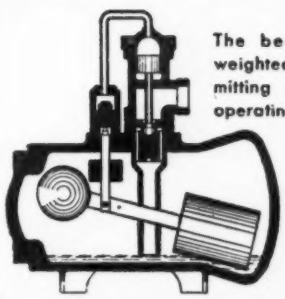


The control of a high rate of flow under high pressure calls for great force to operate the valve.

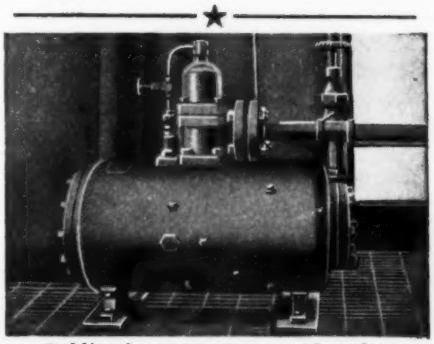
In the Cochrane Discharger this force is provided by a piston actuated by a pilot valve.



As shown in these diagrams, this pilot is operated, not by floats but by displacement bodies of different densities at either end of a beam which tilts with the rise and fall of the water level.



The beam opens the weighted pilot valve admitting steam to main operating valve which instantly opens main discharge valve to full opening, avoiding wire drawing or chatter.



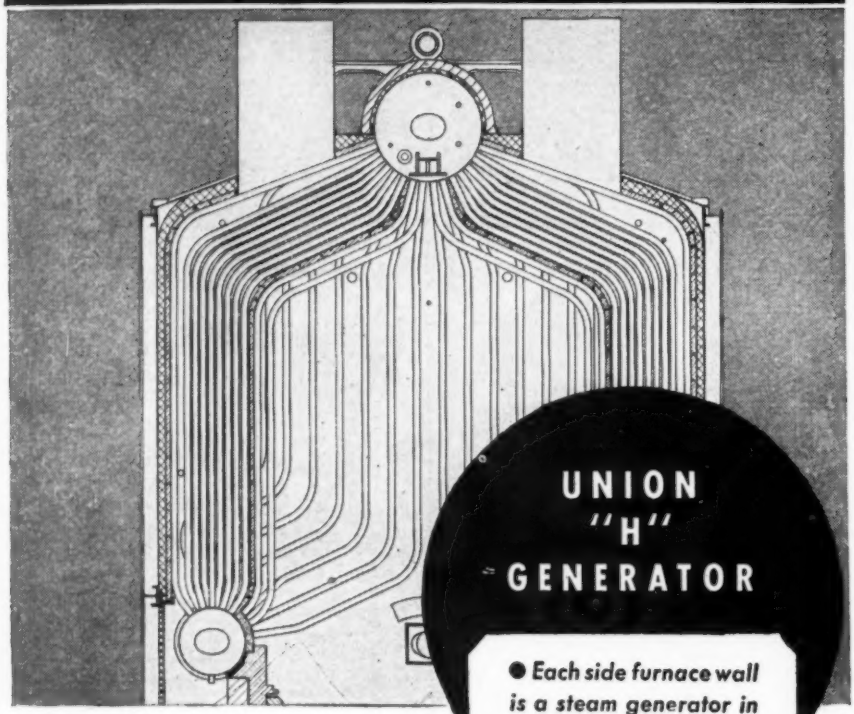
Publication 2935 gives complete data.

COCHRANE CORPORATION

3106 N. 17th St., Philadelphia, Pa.

COCHRANE STEAM SPECIALTIES

UNION



UNION "H" GENERATOR

- *Each side furnace wall is a steam generator in itself, yet an integral part of the boiler unit.*
- *Front and rear refractory walls are protected by a water wall with no complicated headers or circulating tubes.*
- *Lower drums are out of the fire.*
- *Upper drum is fully protected from furnace. Write for Bulletin 27 for the complete "H" Generator description.*

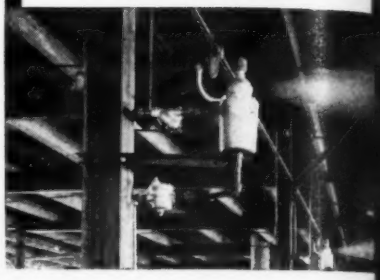
THE UNION "H" GENERATOR is an advanced idea in boiler design that provides large and fast steaming capacity in small space. It is, however, only one of many Union water tube and fire tube boilers, each designed to meet a specific set of conditions. A thorough study of your requirements by Union engineers will tell you whether the "H" type or which type of Union Boiler best meets your steam needs. *Write us today.*

UNION IRON WORKS • ERIE, PA.

BOILERS

PRESSURE VESSELS • PLATE FABRICATION

EXTRA! EXTRA!



Armstrong HUMIDIFICATION Licks Dry Air Problem Read all about it! Free booklet!

AT LAST—a simple, practical, economical quiet HUMIDIFIER that installs as easy as a unit heater. Costs only $100. for 40,000 cu. ft. capacity. Fully guaranteed.

Prevents DRY-OUT-ITIS: Checks fiber breakage, warpage and checking of wood, paper shrinkage, spoilage of certain foods, cracking of leather, weight loss, etc.

BETTER WORKING COMFORT: Improves worker efficiency, fewer winter colds, cuts absenteeism.

CUTS "STATIC" HAZARD: Minimizes fire and explosion hazard from static electricity; prevents dirt.

Used in hundreds of leading plants. Ask for booklet.

ARMSTRONG MACHINE WORKS

812 Maple St. Three Rivers, Mich.

AS LOW AS 2 CENTS PER HOUR!

WRITE FOR BULLETIN

ARMSTRONG STEAM TYPE HUMIDIFIERS

Testing sand for mold making is a regular part of Sivyer procedure.

TESTING MAKES WORTH LOOKING FOR...

One reason why users of Sivyer Castings take no chance on quality is that Sivyer leaves nothing to chance. The testing laboratory works with every department from raw materials to finishing. Each operation is safeguarded by the exacting checks and techniques of science.

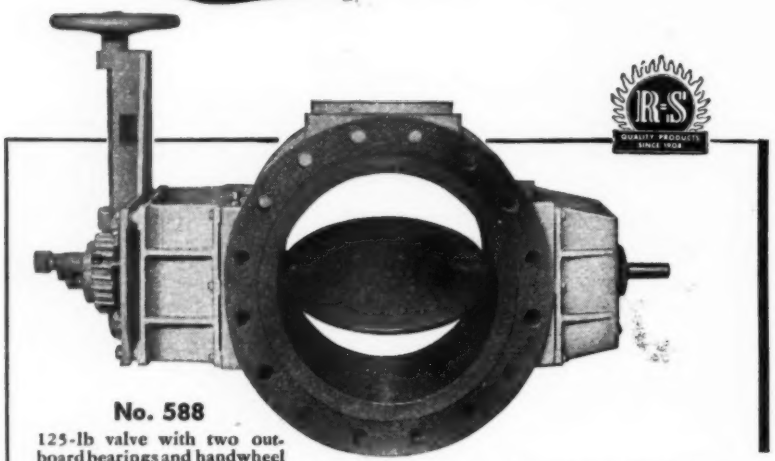
No wonder so many buyers have found the Sivyer mark is worth looking for.

SIVYER STEEL CASTINGS

SIVYER STEEL CASTING COMPANY
MILWAUKEE CHICAGO

NAVY

DOUBLE DUTY
DOUBLE-QUICK ACTION



No. 588
125-lb valve with two outboard bearings and handwheel control.

No. 587
Power operated by air diaphragm motor. Hand wheel for use in case of power failure.

15 to 900 psi
for air, gas, steam, liquids and semi-solids. Substitute metals are available for resistance against heat, abrasion and corrosion.

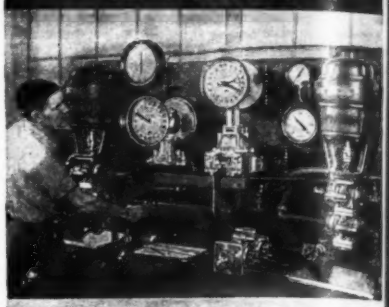
Throughout American Industry, Butterfly Valves have long been recognized as the ideal type for the control of volume and pressure. With the improved R-S precision machined—wedge type design, these valves are also used with equal effectiveness for the shut-off of any material that flows or is forced through a pipe.

The beveled vane seats at an angle against the valve body and tends to close itself under a pressure drop. Four to six revolutions of the hand wheel completely open or close the valve vane—that's double-quick action. Manually or power operated under pressures up to 900 pounds and from extremely high temperatures to sub-zero refrigeration conditions. R-S Butterfly Valves meet today's need for non-complicated construction, simplified operation and lower over-all costs. Write for detailed specifications.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4536 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

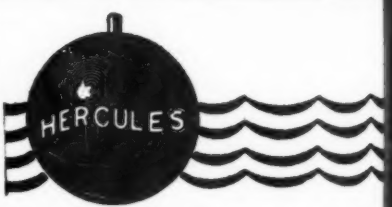
Every IMO is tested



Each De Laval-IMO pump is tested under full load and every purchaser of a De Laval-Imo pump is, therefore, assured that his pump before shipment has demonstrated its ability to handle oil of given characteristics under the specified conditions. This is one of the ways in which our aim always to build the best is achieved in practice. • Ask for Catalog I-113.

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton 2, New Jersey

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

They pioneered on the Santa Fe Trail
—and America is STILL pioneering.

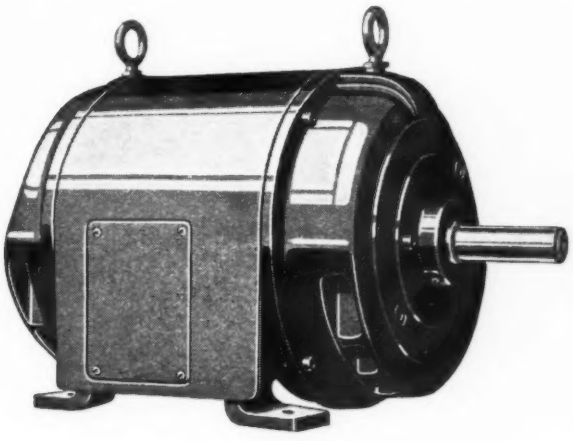
PIONEERS!

Since the days of line shafts, wooden pulleys and dangling belts, Reliance has pioneered in the *application* of electric motor-drive.

Cooperating with machine designers, Reliance engineers have been able to eliminate transmission gadgets—gears, brakes, clutches, belts, couplings—and have made power control exceedingly simple, easy and effective.

The results: lower-priced, better-performing, more salable machines; and, for machine users, stepped-up production with better quality at lower cost.

All Reliance salesmen are Engineers and Pioneers . . . engineers who know electric motors and motor-drive; pioneers, not afraid to tackle something new. Send for one if you need practical, helpful suggestions.



Reliance A-c. Squirrel-cage Motor. Simple, quiet and rugged. THE WORK-HORSE OF INDUSTRY.

RELIANCE A·C D·C MOTORS

RELIANCE ELECTRIC & ENGINEERING CO.
1088 Ivanhoe Road · Cleveland, Ohio

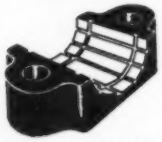
Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville (S.C.) • Los Angeles • New York
Philadelphia • Pittsburgh • Portland (Ore.) • St. Louis • Salt Lake City • San Francisco • Syracuse • other principal cities.

FIVE HINTS ON HOW TO MAKE

BETTER BEARING LININGS

Select the right bearing metal for the service, follow accepted methods of preparing the shell and pouring the metal, keep bearings well lubricated and free from dirt and your bearing troubles will become a thing of the past. While normal wear is to be expected, there is no excuse for cracked, squeezed and "frozen" bearings. The five points listed below have been found to be effective in helping to eliminate common causes of bearing failures.

1



Bearing shell should be absolutely clean...free of old metal, oil, dirt, scale and rust. All anchor holes and grooves should be well cleaned . . . by hand if necessary.

2

Pour bearing metal at the correct temperature . . . the pot should be pyrometer controlled for best results. Use only new metal; addition of scrap of a different formula will change characteristics of the babbitt.

3

Babbitt metals are mechanical mixtures and tend to separate if left alone. Stir over and over ...not around and around. To prevent cooling of metal in ladle, have pot and bearing close together.

4

Use a self-skimming ladle... large enough to hold all the metal needed to pour entire bearing at one time. Pouring too quickly prevents air in mold from escaping and causes blow holes or seams in lining.

5

Most important point of all is selection of bearing metal. 90% of bearings in use today are subject to uniform speed and only moderate pressure, as in electric motors, line shafting and general machinery. For such services, use Magnolia Anti-friction Metal.

When bearings must stand heavy, sustained pressures, such as in rolling-mill machinery, use Pyramid, a hard metal which will not squeeze out.

For shock loads, which would crack the harder metals, use Defender, a tough yet malleable metal. Internal combustion engines and trap rock crushers are typical applications.

GENERAL USE

HEAVY LOADS

SHOCK LOADS

NEW BULLETIN

Write for FREE 8-page bulletin which gives many helpful hints on how to keep bearings on the job and shows what bearing metal to use where.

MAGNOLIA METAL CO.• ELIZABETH, N. J.

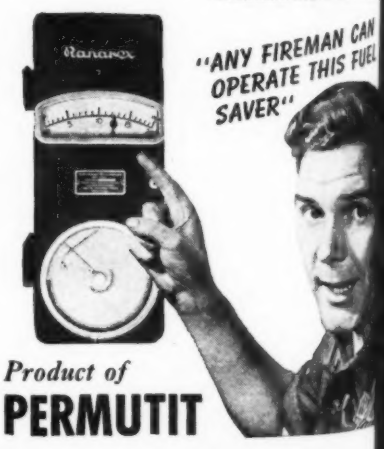
MAGNOLIA BEARING METALS

Cut heat loss with Ranarex

Measure the CO_2 in flue gases with this instrument and you can adjust combustion to the exact point at which you get the most power possible from the fuel consumed. Users report reduction in waste as high as 20%. Ranarex* is so simple it can be taken apart with a screwdriver. It's rugged, too, because it contains no chemicals or fragile parts. Yet it gives instant readings, accurate within 3/10 of 1%. Send for free booklet: The Permutit Company, Dept. A, 330 West 42nd Street, New York, N. Y.

In Canada: Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto...Winnipeg...Calgary.

* Trademark Reg. U. S. Pat. Of



Product of
PERMUTIT

80% OF AMERICA'S SYNTHETIC RUBBER PLANTS ARE FISHER EQUIPPED . . .

LIQUID LEVEL CONTROLLERS • DIAPHRAGM MOTOR VALVES • PRESSURE REGULATORS

Type 2400-248 Level-Trol. 600 lb. cast steel body; 14" float.

FISHER LEVEL-TROLS

. . . . A modern development of Fisher engineering and research, constitute an important part of the control equipment we are manufacturing for over 80% of America's Synthetic Rubber Industry.

The reason for this overwhelming preference for Fisher Level-Trols by both constructing and operating companies is simply this — they can be relied upon to dependably perform the service for which they are specifically designed and built.

Fisher Level-Trols are used for both level control and level indication. Their distinct advantages over conventional ball float types are:

1. . Throttling range adjustment provides wide range of control or application.
2. . 100% Pneumatic pilot insures maximum sensitivity.
3. . Torque tube construction means trouble-free, long life operation.
4. . Level position adjustment for resetting liquid level.

Fisher Level-Trols are available in a complete series for every service requirement. They are fully illustrated and described in Bulletin F-1. Write for your copy today.

ARMY E NAVY

FISHER GOVERNOR COMPANY

• 428 FISHER BUILDING •

MARSHALLTOWN, IOWA

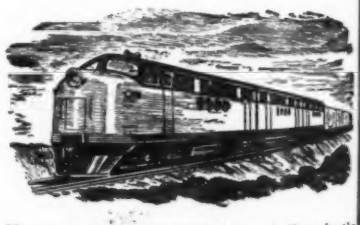
PREVIEW OF TOMORROW'S POWER

IF you want a glimpse of how tomorrow's hard jobs will be done, look at what is doing the tough war jobs today — such jobs as building airfields in the jungle.

Look in tanks and trucks, in landing barges and patrol vessels, in tractors and auxiliaries. You'll find General Motors Diesel Engines packing them with power.

This grueling service is emphasizing the virtues of GM Diesels—highlighting their ruggedness—showing how little fuel they use, and low-cost fuel at that.

With the war won, our expanded facilities will be turned to peacetime needs, and these engines will be available for many applications where America will need dependable, economical power.



New eras of transportation follow in the footsteps of war. Another new era of transportation is assured in the wake of this war. General Motors Diesel Locomotives already are establishing new standards.

BACK THE ATTACK—WITH WAR BONDS

GM
GENERAL MOTORS
DIESEL POWER

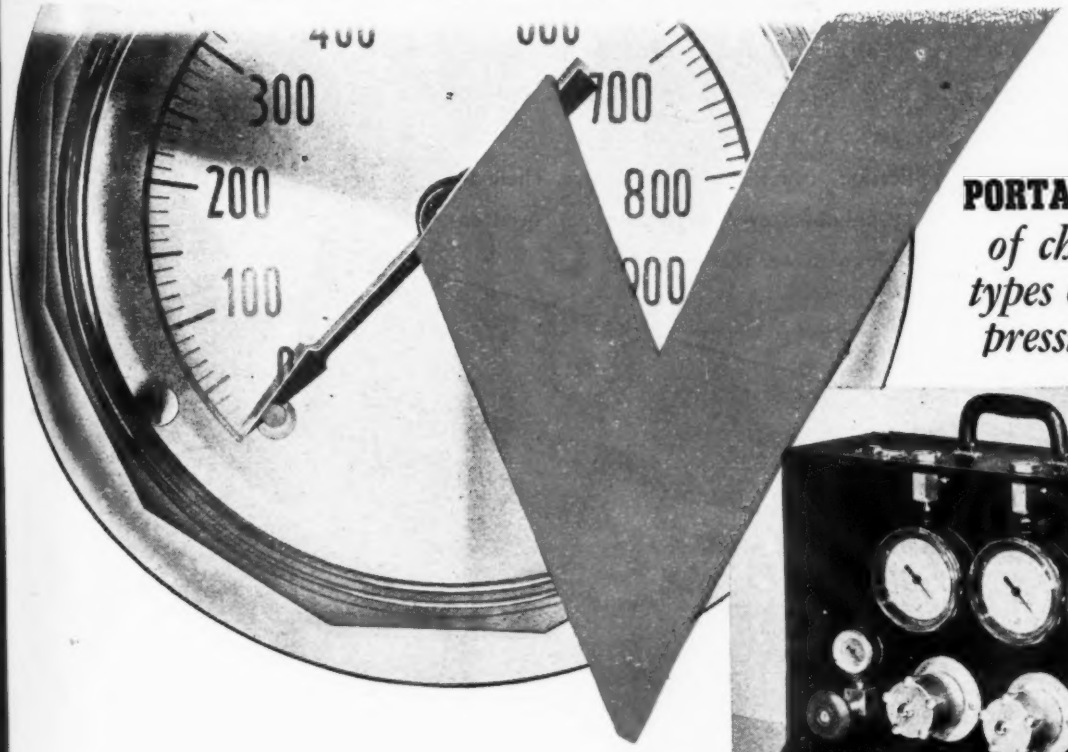
ENGINES.....15 to 250 H.P.....DETROIT DIESEL ENGINE DIVISION, Detroit, Mich.

ENGINES..150 to 2000 H.P...CLEVELAND DIESEL ENGINE DIVISION, Cleveland, Ohio

LOCOMOTIVES.....ELECTRO-MOTIVE DIVISION, La Grange, Ill.

ACCURATELY CHECK THE ACCURACY OF PRESSURE GAUGES

WITHOUT REMOVING FROM PANELS OR MOUNTINGS



The
PORTABLE METHOD
of checking all types of mounted pressure gauges

To check the accuracy of pressure gauges *in service*, it is no longer necessary to remove them from their panels or mountings—nor disturb existing line connections. Consider the value and savings this will effect, especially when there is the slightest possibility of a gauge having been damaged by momentary or sustained overpressure, sudden pressure release, extreme vibration or shock of any sort. With the *portable* Grove Comparator Pressure Gauges of various ranges from 0 to 1000 lbs. can be quickly and accurately checked "in-place" in a fraction of the time—at a fraction of the cost usually required for dismounting, setting up, testing and remounting. Write for Bulletin 300.

AWARDED FOR WORK "WELL DONE"

OTHER GROVE PRODUCTS INCLUDE

- ★ *Air, Gas and Steam Pressure Reducing Valves*
- ★ *Remote Control Shut-off Valves*
- ★ *Automatic Reducing and Stop Valves*
- ★ *Complete Pressure Control System*

GROVE *Pneumatic Gauge* COMPARATOR

GROVE — SIMPLICITY ACCURACY SAFETY

GROVE REGULATOR COMPANY

6527 GREEN STREET, EMERYVILLE, CALIFORNIA

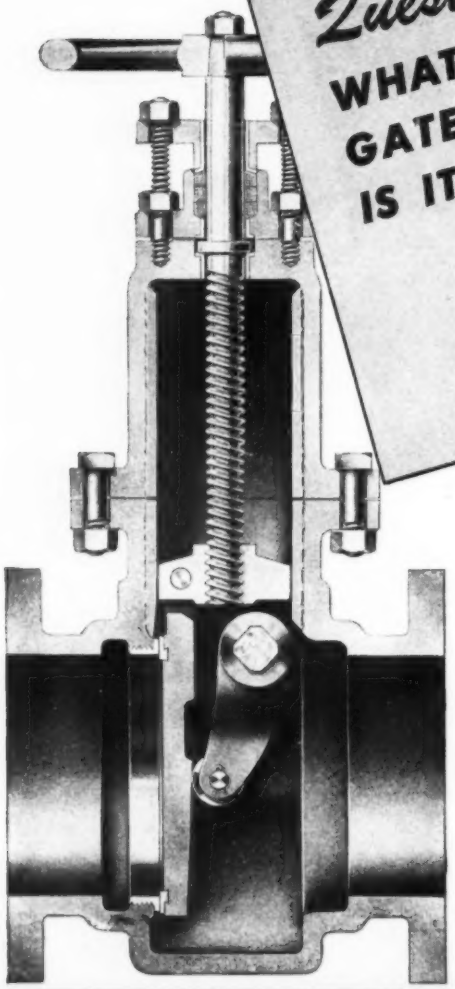
BRANCH OFFICES: 5644 NAVIGATION BLVD., HOUSTON, TEXAS • 30 ROCKEFELLER PLAZA, NEW YORK CITY, N. Y.

Do You Know About ALL the DIFFERENT TYPES OF VALVES?

TODAY, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you specify a valve for that all-important line, be sure it is "the best buy" for the application . . . not just another valve. There are special types of valves which may be unknown even to many experienced engineers. For example, would you be able to answer this question?

Question:

WHAT IS A SAFETY SWING GATE VALVE, AND WHERE IS IT USED?



Answer:

This unique design . . . the Kennedy-Erwood Safety Swing Gate Valve . . . combines the functions of a gate valve, check valve, and relief valve in a single unit. It may be hand-operated as a standard gate valve, but when closed, the adjustable spring-controlled disc will automatically relieve excessive unbalanced pressure in any apparatus or pipe line.

For example, used as a non-return valve on exhaust line between turbine and condenser, this valve protects the low-pressure casing against building up of pressure which might cause failure and serious damage to equipment. Also used as a back-pressure valve, atmospheric relief valve or safety gate valve on pumps, compressors, etc.

If you have a valve selection problem, write to us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

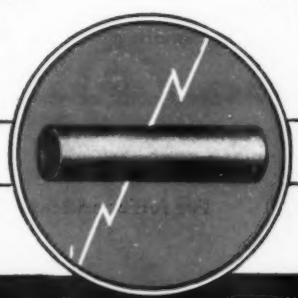
KENNEDY-ERWOOD
Safety SWING GATE VALVES

TALON'S
ELECTRIC WELDED STEEL TUBING

MEETS THESE SPECIFICATIONS

To meet the needs of industry for minimum weight and maximum strength, Talon's Electric Welded Steel Tubing is manufactured from flat-rolled strip steel and tested beyond the required limits of standard specifications. Each coil of strip must meet Talon's rigid requirements for accuracy to chemical and physical properties, gauge, width and finish. Safety, ease of fabrication, light weight, uniform wall thickness and diameter, and concentricity are thereby assured.

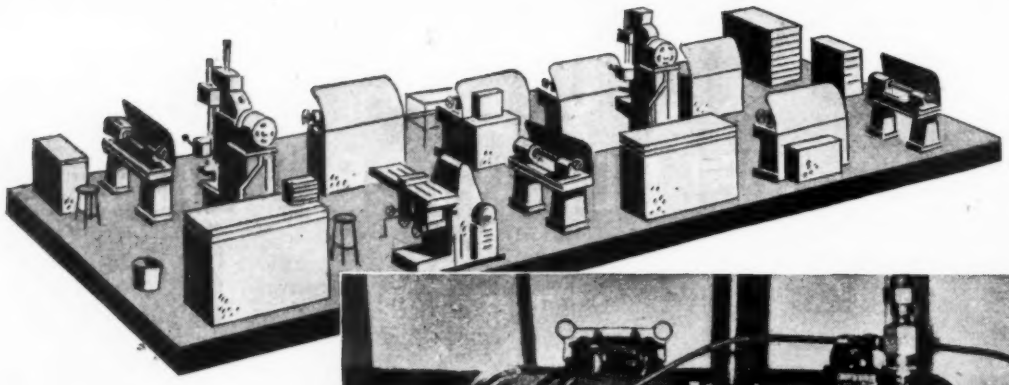
During and after the cold-forming operation, each length is subjected to critical inspection, and every foot of pressure tubing is hydrostatically tested. Grain structure of wall and weld is homogeneous—no extra metal is added in welding. Controlled atmospheric annealing improves physical properties and produces a scale-free finish. Talon's Electric Welded Steel Tubing in sizes from ⅝" to 4" O. D. is available for prompt delivery in lengths up to 40 feet.

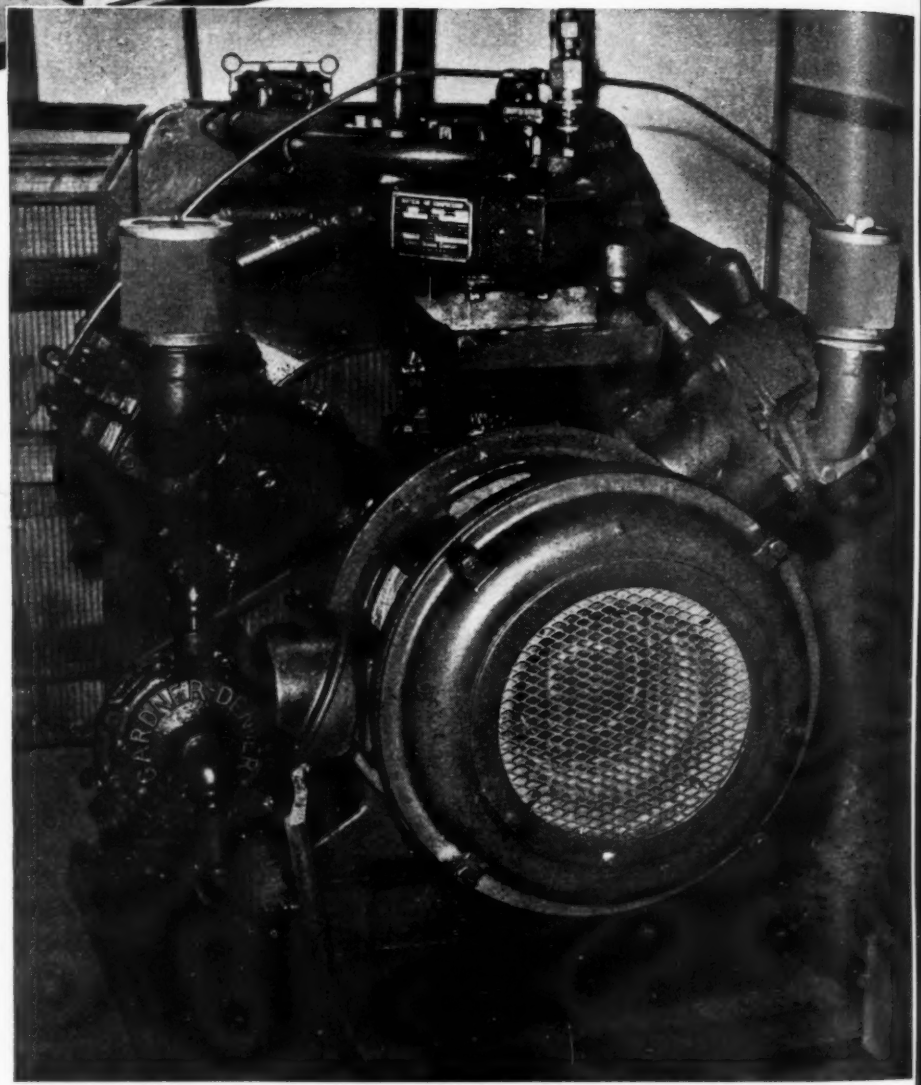


PRESSURE MECHANICAL

TALON . . INC.

STEEL TUBE DIVISION OIL CITY, PENNA.





fits today's ideas of "production density"...

You've probably heard the term "production density"—it means making the most efficient use of every square foot of floor space in a factory. The problem of greater compressed air capacity in limited floor area has been solved in hundreds of plants by the Gardner-Denver "WB" Two-Stage Vertical Compressor—a machine of unusual compactness. Requiring a floor space only about 5 ft. square, the "WB" assures a plentiful air supply at efficiencies comparable to those of large horizontal compressors—plus cost-saving advantages of Gardner-Denver design, such as:

1. Ruggedly designed with castings of GarDurloy, the special Gardner-Denver alloy iron that gives extra strength and hardness where needed.

2. Fully water-cooled cylinders for lubricating oil economy and cooler discharge temperatures.

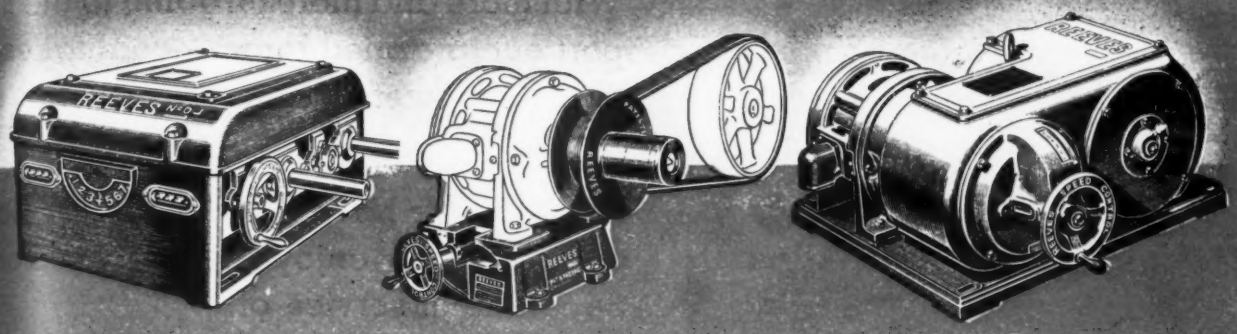
3. Drop-forged crankshafts mounted on Timken roller main bearings.

4. Furnished with direct motor mounting or sheave for "V" belt drive, in capacities from 142 to 445 cubic feet displacement per minute.

For full specifications, write Gardner-Denver Company, Quincy, Illinois

GARDNER-DENVER *Since 1859*

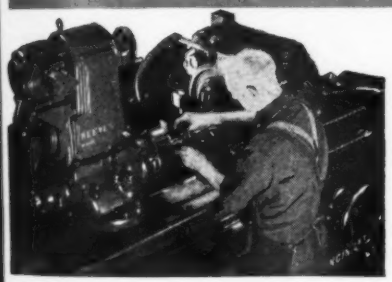
MANPOWER BOOSTERS...



VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over wide range.

VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive.

MOTODRIVE combines motor, speed varying mechanism and reduction gears in single unit.



Manpower problems are perplexing you today as never before. Machine operators must be recruited from the ranks of women and from "white collar" men.

Anything that helps these workers get the hang of their new jobs faster, contributes vitally to our war program. REEVES Variable Speed Drives do this by enabling operators to adjust machine speeds to their own skills, to different sizes and kinds of parts and materials, quickly and accurately without stopping the machine.

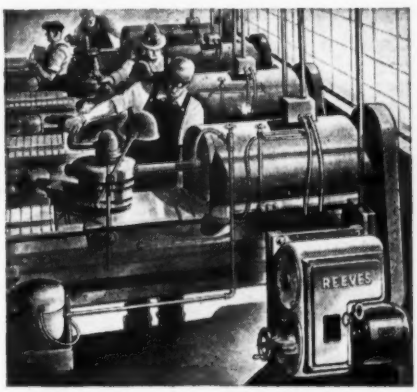
REEVES Speed Control also insures greater precision and enables skilled operators to turn out more work—in many instances doubles productive capacities of men and machines.

Many Designs and Models

The three basic REEVES units shown above are made in a wide range of designs and sizes. One of these units can be quickly installed on any type or make of production machine to provide "stepless" speed adjustability. Full description of REEVES units and their use in more than 25,000 plants throughout industry is contained in 124-page Catalog-Manual P-419. Send for it.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Recognized Leader in the Specialized Field of Speed Control Engineering



GUN PART PRODUCTION INCREASED 25%

—in this Detroit machine shop, without extra machines, extra labor or extra floor space—when REEVES Variable Speed Drives were installed.

REEVES *Accurate Variable* SPEED CONTROL

FUEL OIL HAS GONE TO WAR

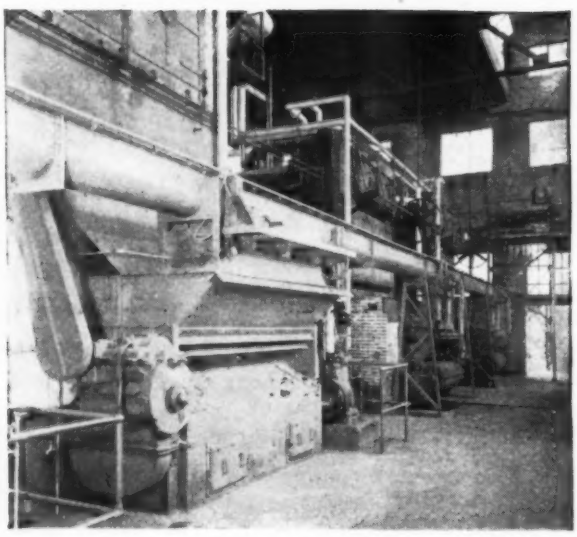
★ ★ ★

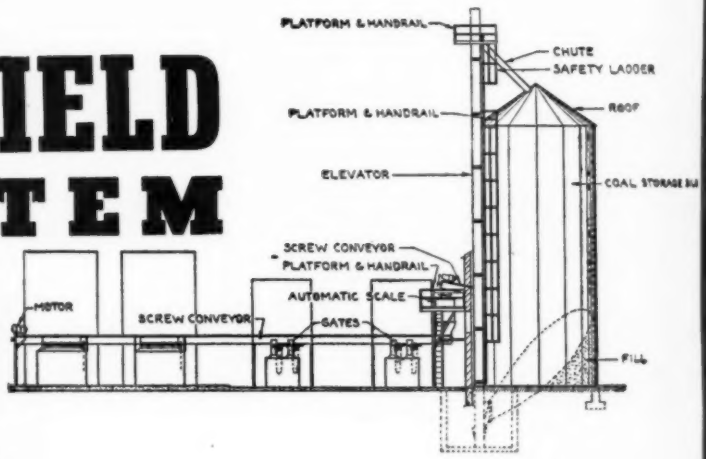
COAL COMES TO THE SUPPORT OF THE HOME FRONT

With more and more oil going to the support of our armed forces—coal takes on greater power responsibilities for our Home Front.

Many plants have already converted to coal and are enjoying the carefree—dependable service of

THE FAIRFIELD SILO SYSTEM





Here is a clean, automatic system of coal storage and handling that is complete. The Fairfield Engineering Co. takes the full responsibility from design to finished structure including all allied equipment for handling coal from car to stoker or pulverizer.

The silo itself is made of vitrified tile and requires very little space. The entire system is designed to meet your individual conditions and at a cost that is reasonable.

OUR CATALOG illustrating a number of successful installations covering various operating conditions will be sent upon request. Our Engineers are also available for consultation. Write for an interview.

THE FAIRFIELD ENGINEERING CO.- MARION, OHIO
BUILDERS OF COAL AND ASH HANDLING EQUIPMENT

For the Most Efficient Speed . . .
. . . for each machine . . .
. . . for each operator . . .

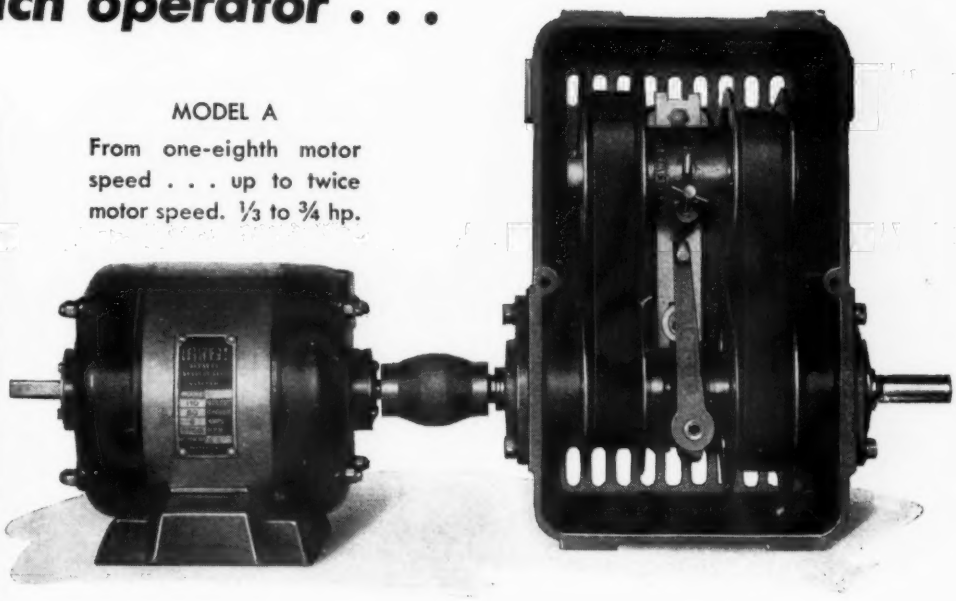
Check

The WORTHINGTON ALLSPEED DRIVE FEATURES

- Single-unit construction . . . compact and strong
- 16 to 1 speed ratio . . . highest speed ratio in its price range
- Positive automatic belt tensioning . . . without springs
- Absolute assurance of smooth efficient operation
- Can be installed in any position . . . on any machine, new or old
- Can be used with any standard motor, 1725 to 1800 r. p. m.
- Operates in either direction . . . direct-connected to motor or through V-belt or flat-belt drive

MODEL A

From one-eighth motor speed . . . up to twice motor speed. ⅓ to ¾ hp.

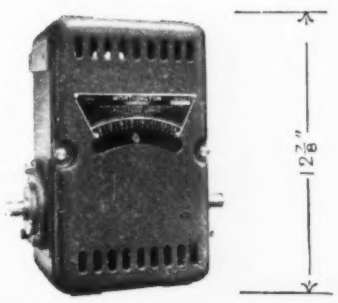


The WORTHINGTON ALLSPEED DRIVE

Reports from many plant engineers and time-study men show that their production has been stepped up 25% to 200% with this equipment. Another war-time value is the fact that it simplifies the training of machine operators . . . by permitting initial operation at low speeds, increasing the speed gradually as skill is acquired.

The advantages of such FINGER-TIP SPEED CONTROL are many and far-reaching. There are probably applications in *your* plant in which the Worthington Allspeed Drive could be used to advantage.

Write for literature . . . and ask the nearest Worthington office or dealer for a demonstration



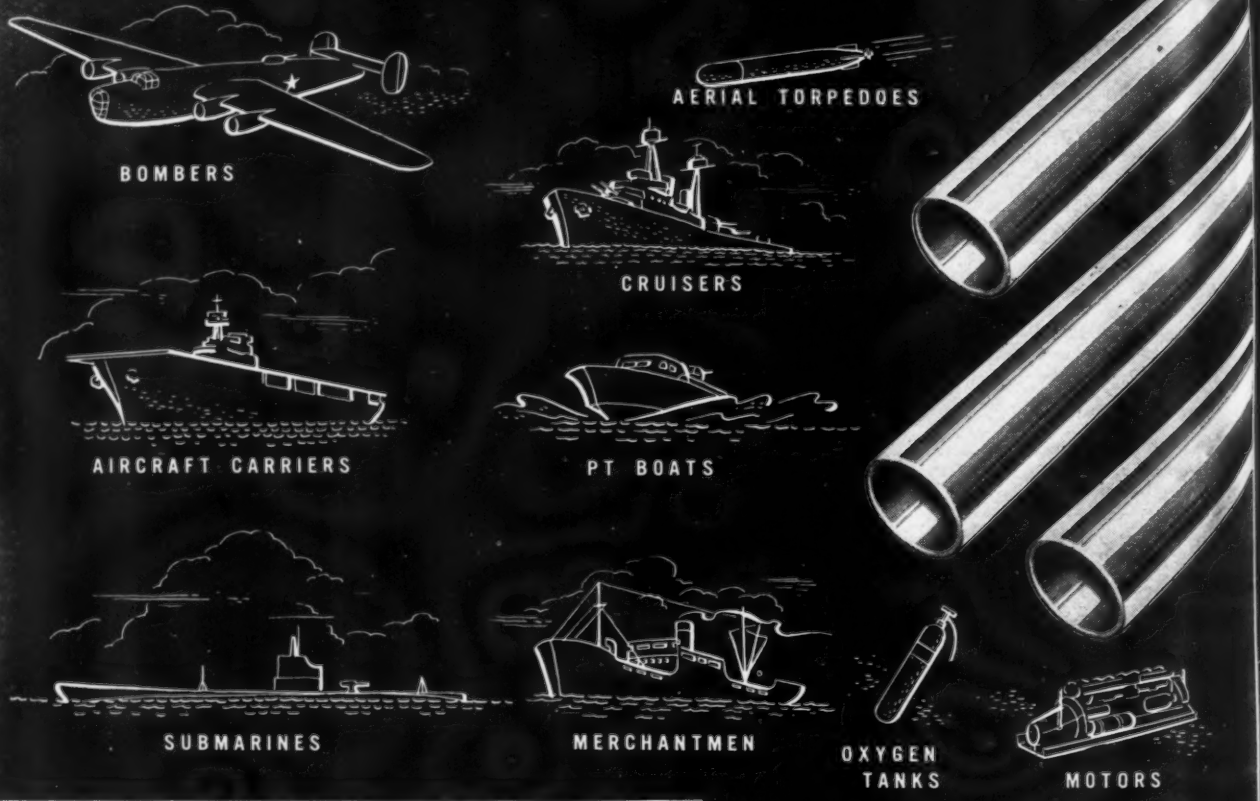
MV3-6

WORTHINGTON

WORTHINGTON PUMP & MACHINERY CORPORATION • GENERAL OFFICES: HARRISON, N. J.

GLOBE STEEL TUBES

. . . Basic Material in the Construction of all Types of Military Equipment



Strength with minimum weight — uniformity of structure and characteristics — easy machine-ability — adaptability to a wide range of needs — these are a few of many advantages of Globe Steel Tubes that have given them an important place in the construction of all types of military equipment.

GLOBE STEEL TUBES CO. • Milwaukee 4, Wisconsin

- Boiler & Pressure Tubes
- Condenser & Heat Exchanger Tubes
- Mechanical Tubing
- Stainless Tubes (Seamless)
- Stainless Tubes (Seamless)
- Gloweld Tubes (Welded Stainless)
- Globeiron Tubes (Seamless Pure Iron)

GLOBE TUBES

Carbon — Alloy — Stainless Steels

But boiler tubes are too vital to burn up needlessly

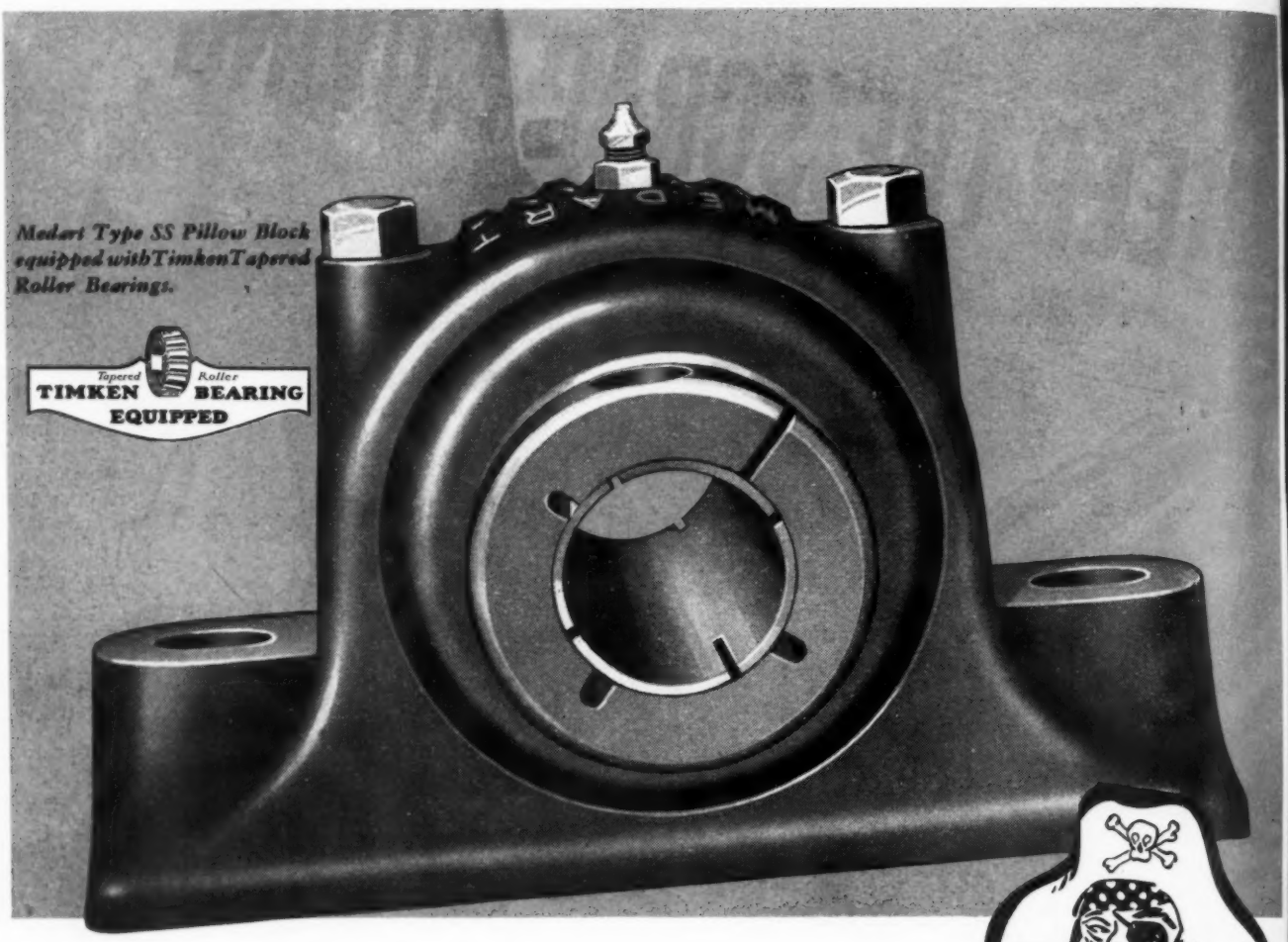
. . . and it is not necessary to tie up your boilers, due to premature tube failures caused by scale formation. Avoid shutdowns, worry, extra overtime work, and expense caused by boiler scale. Of course, when tubes are rendered useless, see that they get into the scrap quickly, and keep the scrap moving to hungry open hearths to be converted into war materials.

Dearborn Treatment and Engineering Service is designed to fit the special operating conditions of your individual plant. It is balanced to provide full protection against scale and corrosion and to reduce the possibility of steam contamination. Dearborn Engineer is nearby to help you. Call or write. Dearborn Chemical Company, Dept. D, 310 S. Michigan Ave., Chicago 4, Illinois.

[Keep the scrap moving . . . and buy still more War Bonds and Stamps]

Dearborn
TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE



Medart Type SS Pillow Block equipped with Timken Tapered Roller Bearings.

Tapered Roller TIMKEN BEARING EQUIPPED

NO DANGER OF *POWER PIRACY* HERE

Power passes smoothly, safely, dependably through Timken Bearing Equipped pillow blocks and line shaft hangers. Friction, the power pirate that infests obsolete transmission equipment is foiled at every bearing point—and with it its destructive associate, wear.

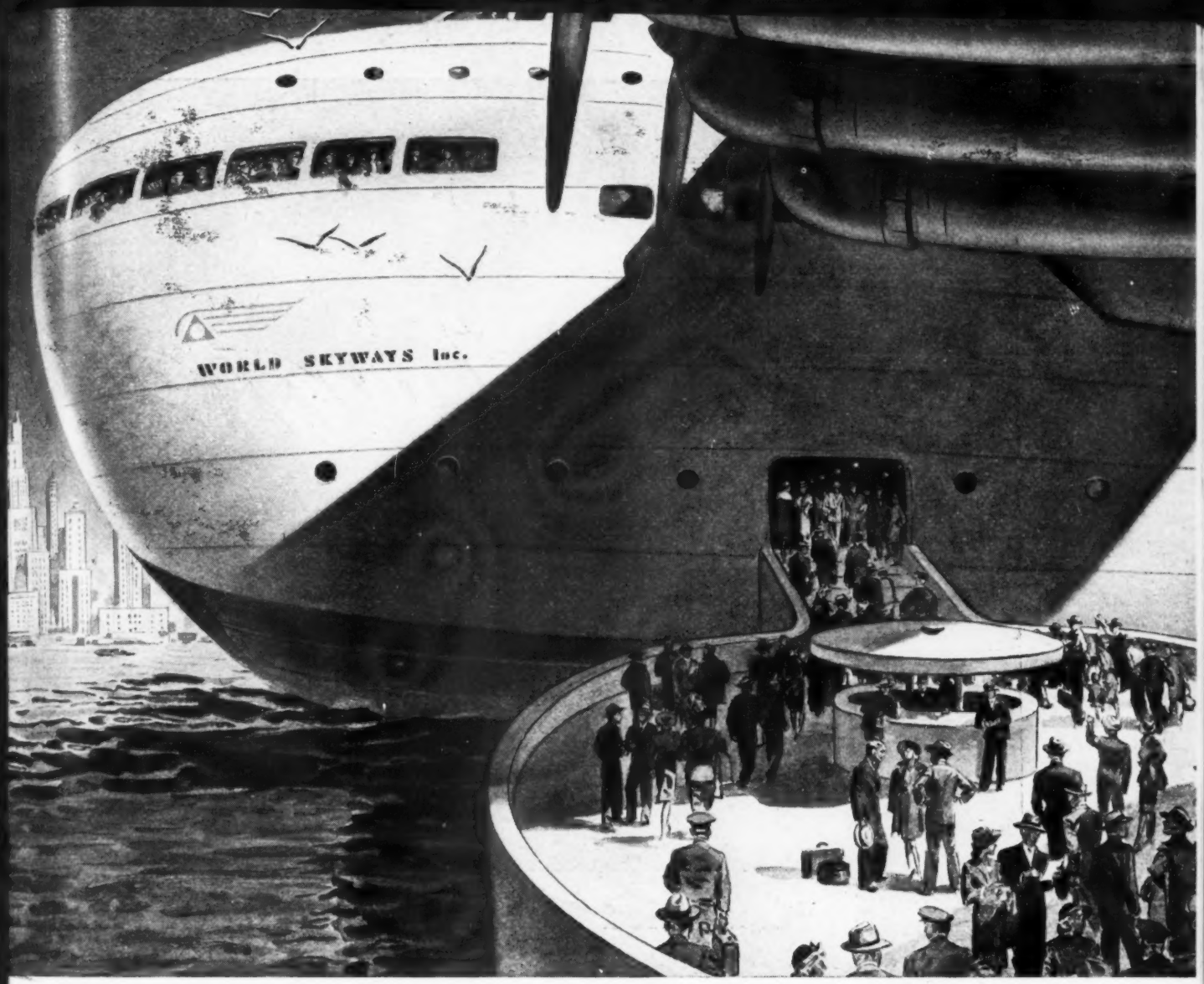
Radial, thrust and combined loads and misalignment —other murderous members of the piratical crew— likewise strive in vain to get in their deadly work; for Timken Bearings provide full protection for power under all conditions of transmission and application. They also increase the endurance and extend the life of the equipment itself — as equipment manufacturers and users alike can testify. The Timken Roller Bearing Company, Canton, Ohio.

Stiff competition may follow Victory; be ready for it with better-performing equipment containing more Timken Bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



BETTER GEARS FOR TOMORROW'S SKYLINERS

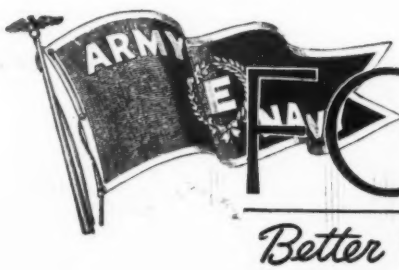
A new era in transportation is on the way! Already skyliners of the future are past the experimental stage, and tomorrow promises a world of short distances—a world where Bagdad and Cairo, Moscow and Budapest will be little more than sleeper jumps from New York.

The giant engines to power these airliners of the future are today a reality. The war's end will find them ready to take over the transportation problems of a world at peace.

Making gears for these engines is Foote Bros.' job. And these gears represent a new advance, both in gear design and gear manufacture. For transmitting the great loads developed by modern aircraft engines demands heretofore unheard-of standards of precision —a precision that must, of necessity, be coupled with extreme lightness. Today these gears are rolling off Foote Bros.' production lines in amazing quantities —gears that mark a revolutionary development in the transmission of power.

When the war is won and these new gears can be produced for peacetime industry, they give promise of new efficiency—new economy to American manufacturers, whether they be applied to skyliner engines or machine tools, farm machinery or motor cars.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 South Western Boulevard • Chicago, Illinois



FOOTE BROS.

Better Power Transmission Through Better Gears

Good water BY PERMUTIT BIG DOUGLAS

"Controlled Conditions" plant includes control of water quality

Everything's under control at the giant new Douglas plant in Oklahoma City, designed by The Austin Company for maximum production. This streamlined eagle's nest has windowless walls that "breathe," continuous fluorescent lighting, "invisible-painted" inside walls, heat-insulation—and of course Permutit* water conditioning. Permutit hot lime soda water softeners and Deaerators keep the boilers and steam lines free of scale and corrosion, preventing shutdowns for turbining and replacement of hard-to-get tubes. Permutit continuous blowoff equipment reduces foaming and priming.

Douglas is just one of the thousands of war plants where good water by Permutit is helping to do a tough production job well. Permutit makes every type of water conditioning equipment. Write us about *your* water problem. The Permutit Co., Dept. A, 330 West 42nd St., New York 18, N. Y. In Canada: Permutit Co. of Canada, Ltd., Montreal. *Trademark Reg. U. S. Pat. Off.

Serving industry and the armed forces . . . with GOOD WATER

PERMUTIT

WATER CONDITIONING HEADQUARTERS

T HELPS BUILD
SSKY TRAINS!

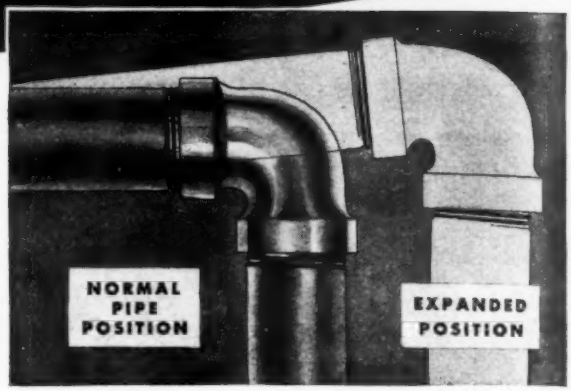
Do You Realize . . .

. . . THAT A LOW PRESSURE STEAM SUPPLY LINE 1000 FT. LONG MAY EXPAND MORE THAN 15" WHEN STEAM IS ON?

. . . THAT A RETURN LINE 1000 FT. LONG MAY EXPAND MORE THAN 10"?

. . . THAT YOU CAN NOT PREVENT IT?

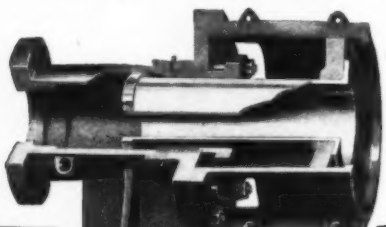
. . . THAT YOU MUST PROVIDE FOR IT?



● Although there is less expansion in low pressure than in high pressure steam lines, it acts just as surely and provision must be made to take care of it. While the hazard from broken pipe or fittings may be less, it is by no means negligible.

It is a mistake to spend good money to install a piping system, then impose undue stress on the piping by failing to provide for the inevitable contraction and expansion.

Sound engineering practice and good common sense dictates the wisdom of installing ADSCO Expansion Joints. Simple tables in the ADSCO Catalog, cuts and descriptions show which type is best suited to your needs. Write for catalog 35PR or describe your problems and we will be glad to assist you in making a choice.



CONTROL EXPANSION WITH ADSCO INTERNALLY-EXTERNALLY GUIDED EXPANSION JOINTS

This joint meets the Army and Navy specifications for installation on defense projects — thousands now in use. The internal and external guides keep the slip in true alignment, prevent damage to packing or slip. Available in single or double joints for high or low pressure service on steam, hot water, oil, gasoline, gas or process lines.

AMERICAN DISTRICT STEAM COMPANY
N. TONAWANDA, N. Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT FOR OVER 60 YEARS.

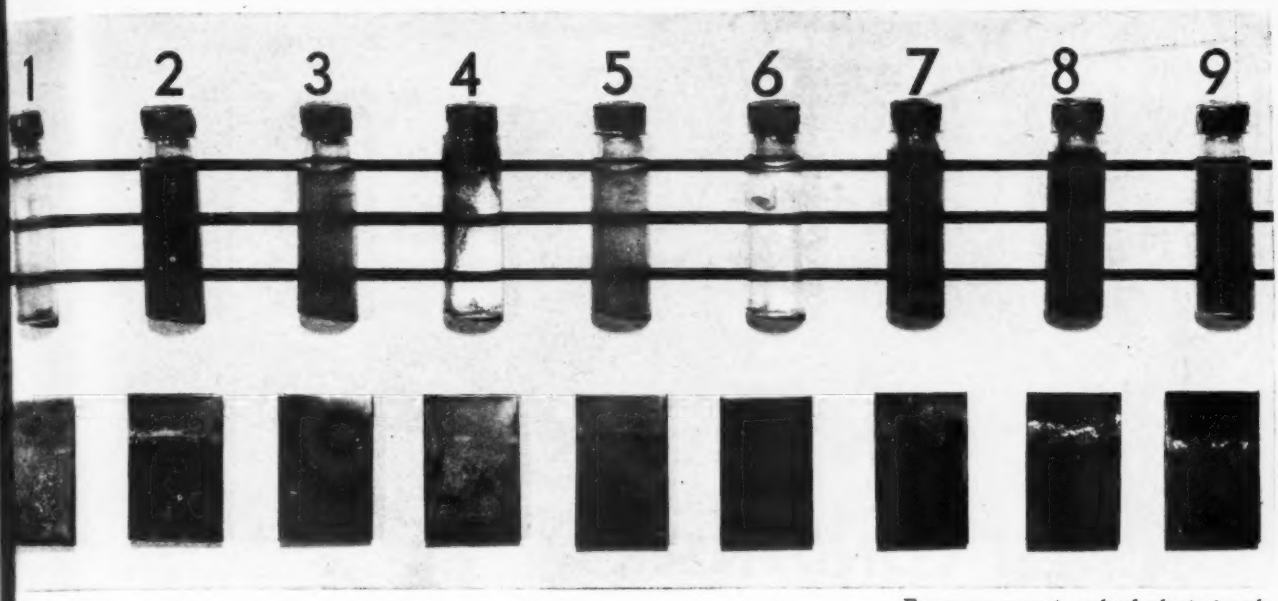
Relative size of ADSCO Expansion Joints and pipe bends for an 8" pipe with 4" expansion. ADSCO Expansion Joints save space — make a more workmanlike job.

ADSCO EXPANSION JOINTS

Eliminates cumbersome pipe bends

TEST RESULTS

ANTI-CORRODE vs. Competitive Products



From an unretouched photograph.

To substantiate our convictions that Anti-Corrode is an unexcelled rust-preventive, nine steel strips were cut from a sheet of No. 18 B. & S. deep drawing steel which had been thoroughly cleaned mechanically. One strip, number 6, was dipped in Cities Service Anti-Corrode. Seven others were treated with leading anti-rust compounds according to their manufacturers' directions. One strip, number 8, used as the control, was not treated.

All strips were then partly immersed in small bottles of distilled water containing 3% Sodium Chloride. At the end of 90 hours they appeared as displayed above. Each test strip is shown before its bottle of solution. The rust penetration on each strip is plainly evident. The background lines behind the bottles enable comparison of rust density found in the solutions after test. The superiority of Anti-Corrode — number 6 — is obvious.

OUTSTANDING QUALITIES OF ANTI-CORRODE

Anti-Corrode is harmless to metal. It can be applied by brushing, spraying or dipping, and is a reliable safeguard against corrosion of metals in any form or state of finish, whether in storage or in transit. Anti-Corrode forms a tenacious, durable film that is impervious to moisture and the more common gases present in the atmosphere. Since it contains lubricating material, it need not be removed in drawing operations. It can be removed easily with kerosene or any petroleum solvent.

USERS' COMMENTS ON ANTI-CORRODE

"Our castings that have been properly dipped in Anti-Corrode show no signs of rusting after a month's exposure to rain and snow."

Assistant Plant Supt.
Large manufacturer of filters.

"We are pleased with the test results of Anti-Corrode on our rust problems and will place a substantial order with you shortly."

Manufacturer of special tools and accessories.

"$8,000 worth of dies were recently ruined by rust. This costly waste of vital materials is now being prevented with Anti-Corrode."

Manufacturer of ballistic dies.

"Condensation of moisture in storage vaults had been rusting our highly-precisioned tools and dies. Anti-Corrode has licked this problem."

Manufacturer of precision instruments.

Take advantage of the FREE demonstration offer. Send the coupon NOW! (Available only in the Cities Service marketing territory EAST of the Rockies.)

CITIES SERVICE OIL COMPANY
Room 1751
Sixty Wall Tower, New York 5, N. Y.

I'd like to test Anti-Corrode on my own equipment FREE OF CHARGE. Please send me the details.

Name _____

Company _____

Address _____

City _____ State _____

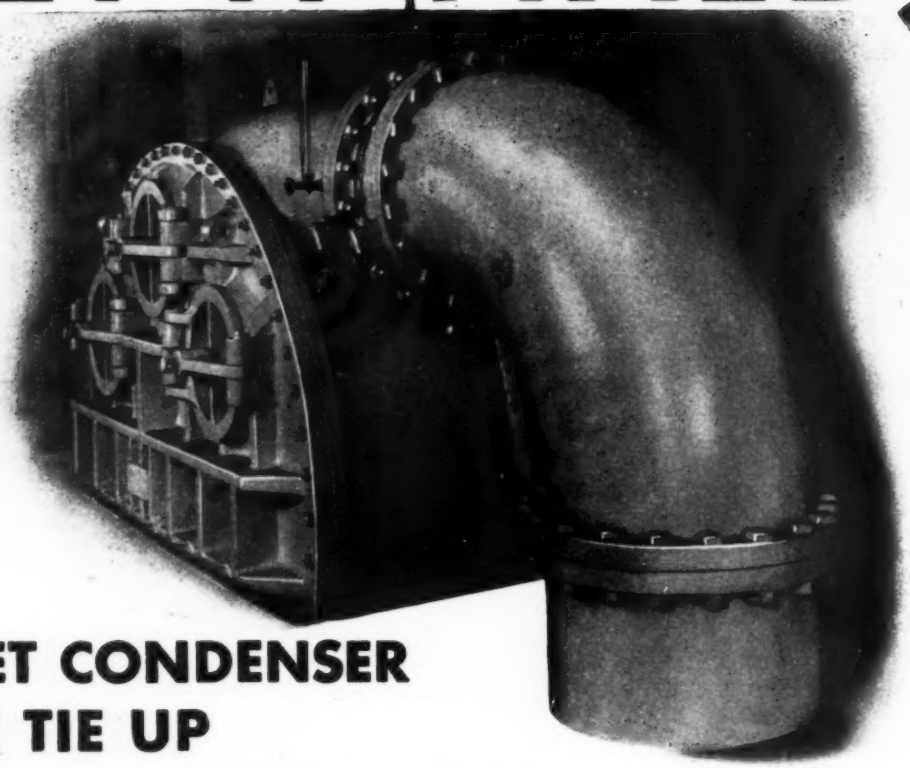
OIL IS AMMUNITION—USE IT WISELY!

CITIES SERVICE OIL COMPANY
NEW YORK · CHICAGO

IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

Tune in Friday Night "The Cities Service Concert" 8 P.M. EWT, NBC Network.

GET IT FIXED!



DON'T LET CONDENSER TROUBLE TIE UP *vital* EQUIPMENT

Why wait for an actual failure that might force a shutdown at a time when you can least afford production stoppage? By planning overhaul *now*, you can *schedule* your shutdown — off peak.

Those who have had a Conseco overhaul . . . and there have been many . . . know how fast and thoroughly we work. Here's why:

- ***Our men are Specialists*** — for 15 years we have been servicing condensers and heat exchangers for utilities and for industrial plants all over the country. We know the fastest practical way to tackle your job.
- ***We have our own technique and tools*** — developed for the express purpose of servicing condensers, to give you a better, faster job.
- ***It is a nation-wide 24 hour service*** — men, facilities, and often complete replacement materials are immediately available.

A wire or phone call will start your job rolling to fit *your* schedule.

Condenser Service

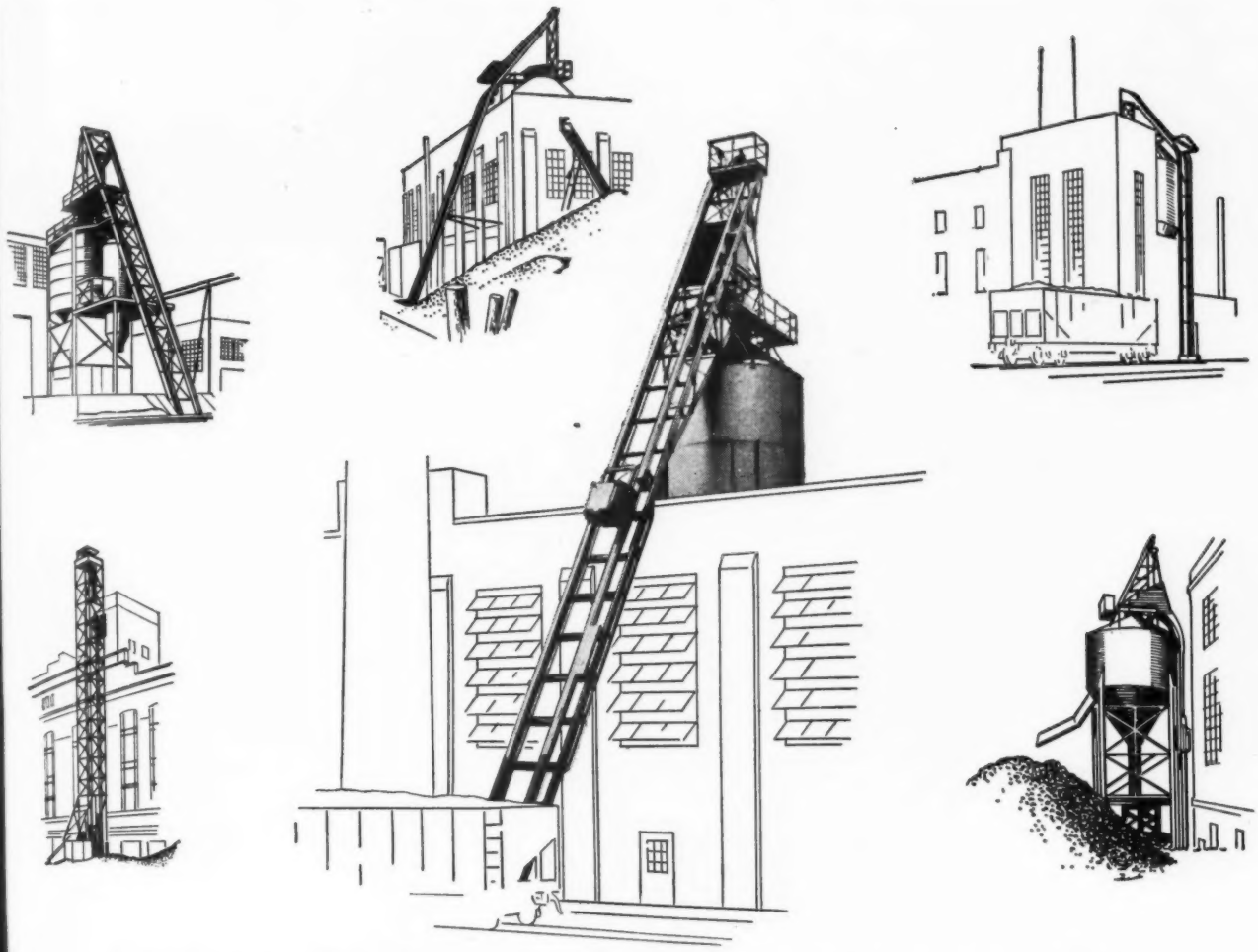
AND ENGINEERING CO., INC

81 RIVER STREET, HOBOKEN, NEW JERSEY

★

NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4**



They tick away the years to the *Rhythmic Flight* of their buckets

● Skip Hoists—*(conceived and developed by Bartlett-Snow Engineers, whose first installation, made in 1907, is still in active daily service)* —are ideally used when the lift is high and the material abrasive. Those of Bartlett-Snow design featuring the many improvements built into our equipment during this 36-year period, are coming into constantly wider use for handling coal in central stations and industrial boiler plants.

Bartlett-Snow Skip Hoists will raise coal from the track hopper to an overhead bunker for delivery to a weigh larry, larry car, belt conveyor, flight conveyor or other distributing system with unsurpassed dependability and at low cost. They avoid banging—and spilling—at either the loading or discharge points—operate without manual supervision until the track hopper is empty or the overhead bunker filled —and—with only reasonable inspection and lubrication, will give not years, but decades, of faithful, dependable, reliable service.

Our Bulletin No. 83, which describes in detail the use of Skip Hoists in handling coal, and contains much other information of interest to every works manager, engineer, and power plant superintendent, will be sent gladly on request to—Coal Handling Department—The C. O. Bartlett & Snow Co., 6205 Harvard Ave., Cleveland, O. Why not send for a copy today?

BARTLETT-SNOW COAL HANDLING

CENTRAL STATIONS and INDUSTRIAL BOILER PLANTS

TRACK HOPPERS • SKIP HOISTS • BUCKET ELEVATORS • BELT CONVEYORS
BINS AND BUNKERS • WEIGH LARRIES • FIELD STORAGE • ASH HANDLING

The TERRY

TERRY
SOLID WHEEL TURBINE
ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

— The Terry wheel will withstand abuse that would wreck any built up wheel.

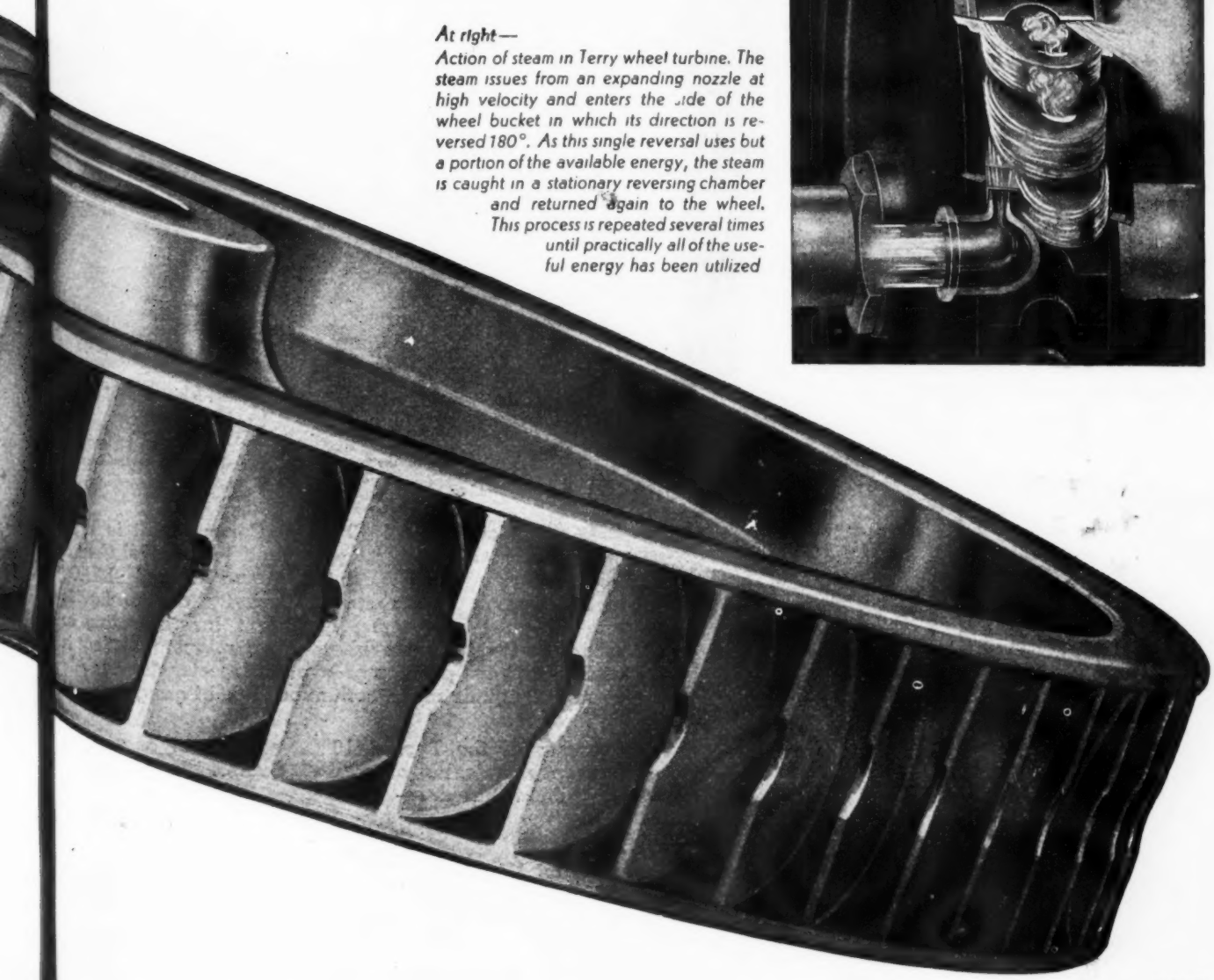
THE TERRY STEAM TURBINE CO.

Wheel Turbine

The Terry Solid Wheel Turbine is available in ratings from 5 HP to 2000 HP. It is built for all commercial steam pressures and exhaust pressures. Thousands of them are in daily service in central stations, industrial plants and on board naval vessels.

Full details of the Terry Solid Wheel Turbine will be gladly sent upon request. Ask for Bulletin S-116.

At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized



T-1147

TERRY SQUARE - HARTFORD, CONN.

HANLON-WATERS Announces—

an OUTSTANDING DEVELOPMENT

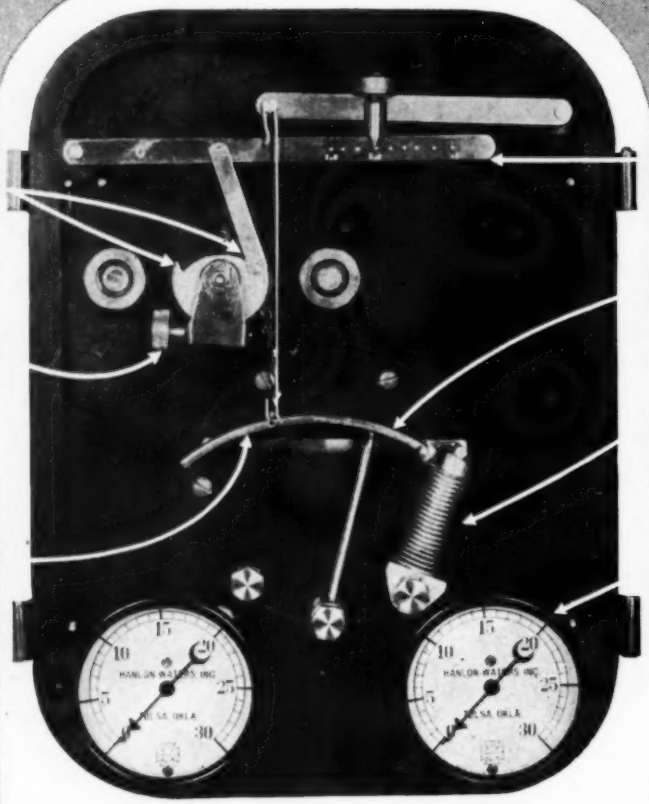
IN Level Control Pilots

for

- REFINING
- CHEMICAL
- SYNTHETIC
- GASOLINE
- RECYCLING

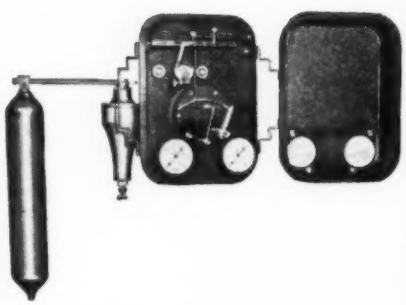
and

- POWER INDUSTRIES

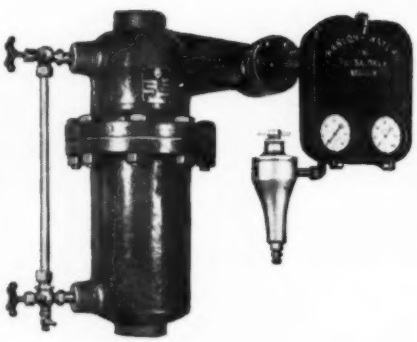


- Simplified-Reversibility
- Adjustment for height of Level Control.
- "Snap Action" settings on Pilot without use of any additional parts or special tools.
- Specific gravity index scale setting from .10 to 2.0.
- WIDE THROTTLING RANGE adjustment from Zero to 300% —setting in exact relation to specific gravity setting.
- Long life bellows, operating throttle arm.
- Straight line pilot characteristic of pressure output to diaphragm vs. level variation.

no THE LEVEL CONTROLLER WITH STUFFING BOX . . . . . LEAKAGE . . . . . FRICTION



- Wide swinging door — easy accessibility of all parts.
- Mountable on any H-W Type 850 Displacement Level Control.



- Equipped with the popular H-W Type 245 Supply Medium Regulator.

H-W New Type 1410 Level Control Pilot is especially designed to meet requirements for a Level Control Pilot having a VERY WIDE "Throttling Range"—EXACT in its relation to the specific gravity of the liquids handled in the system. Important for indicating or recording level service where the displacement float is used to indicate position of level in vessels where highly corrosive liquids make continuous use of gauge glasses impossible.

Features of the Type 1410 Level Control assure performance matching other H-W Control Equipment that are—

STANDARD FOR *Performance*

Hanlon-Waters, Inc.

TULSA, OKLAHOMA

Information on all HANLON-WATERS Equipment is available at representative nearest you.

NEW YORK, CHICAGO, PITTSBURGH, PHILADELPHIA, ST. LOUIS, DENVER, LOS ANGELES, SHREVEPORT, LA., FORT WORTH, HOUSTON, CORPUS CHRISTI and ODESSA, TEXAS

BETTER VALVES FOR STEAM POWER PLANTS COME OUT OF THE WAR

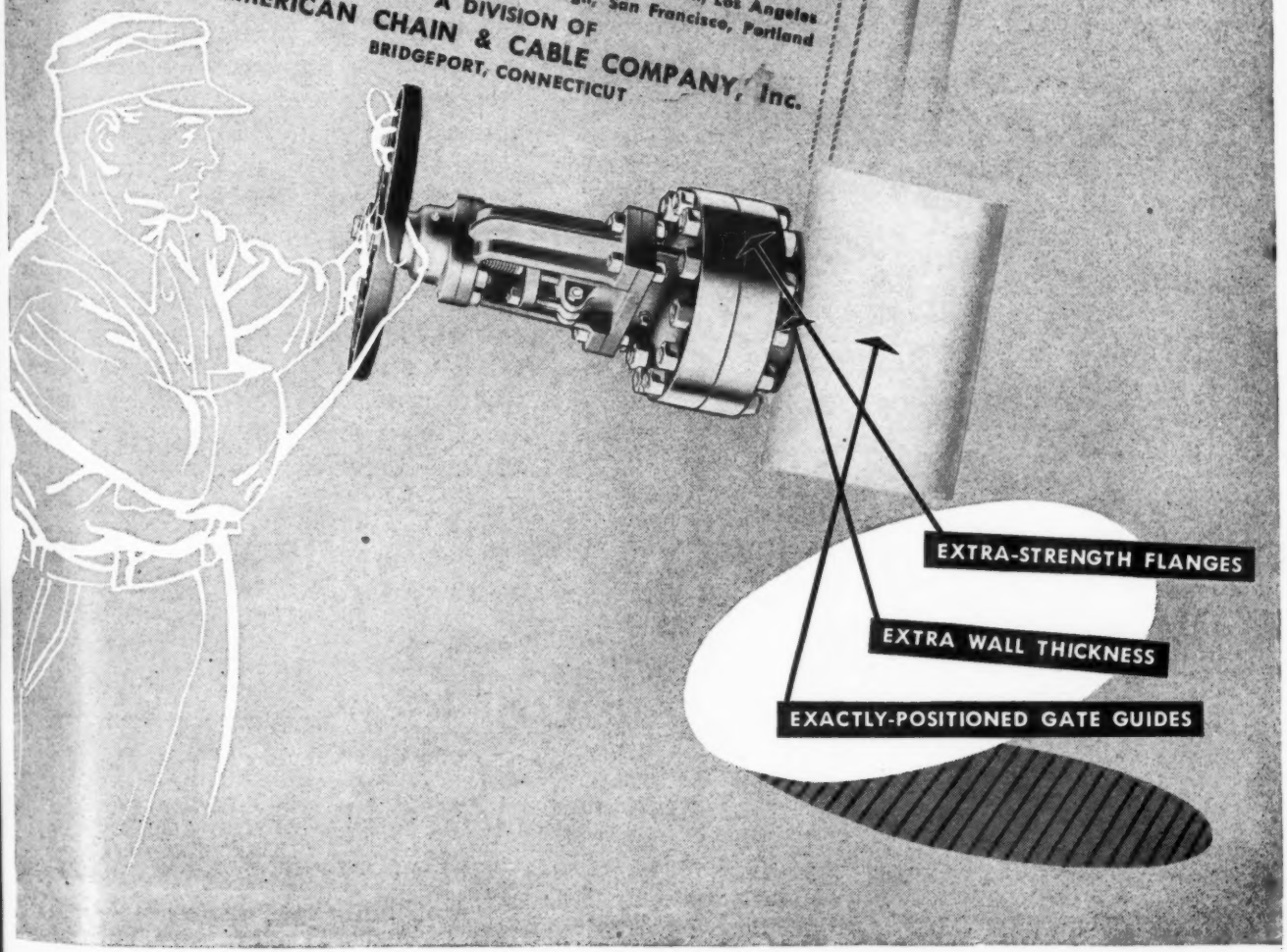
The valves you held have gone through over two years of relentless pressure on all angles of their production. . . . The valves made have gone to war. They continue to take the most direct route to war. So far, none have become available for routine use. . . . But, mark this down: the demands made upon us by this war of which no sane man wants a part have brought to us a wealth of added "know how and better"—things fried out in the heat of intense production—on specific points of the very valves we will be producing for you as soon as there is relief from the pressure upon us. Better Valves for Steam Power Plants have come out of the war.

ACCO

READING-PRATT & CADY

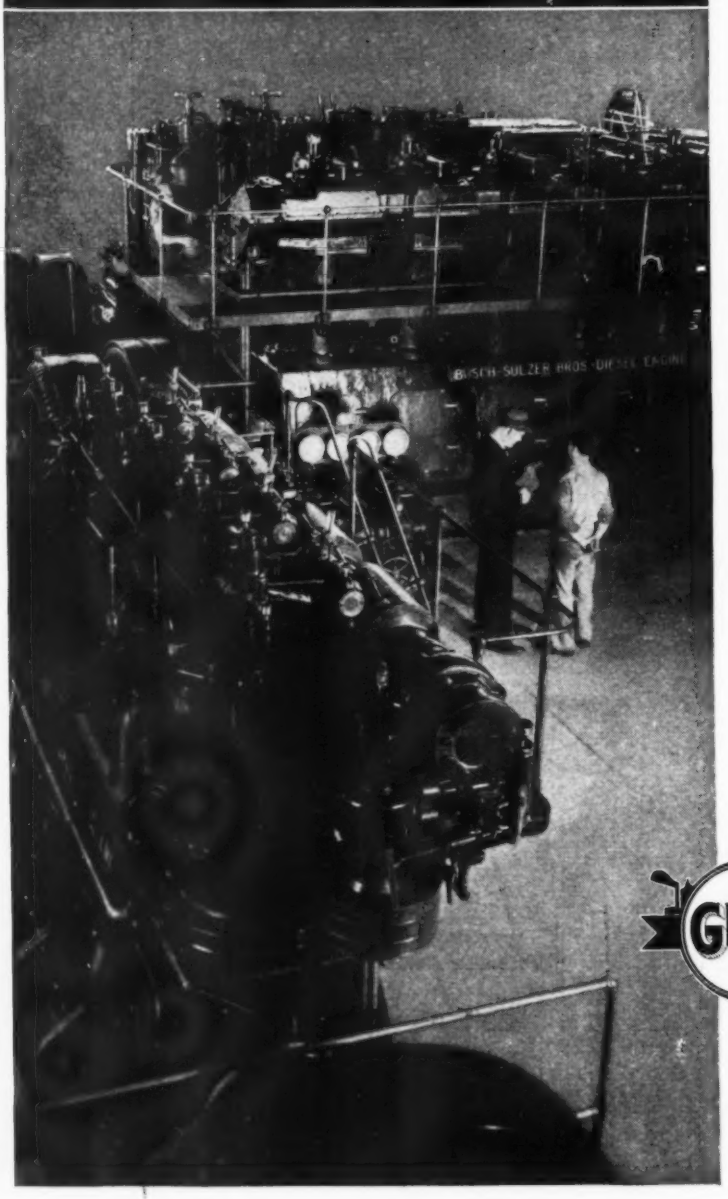
MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES • D'ESTE VALVE AND ENGINEERING SPECIALTIES
Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles
New York, Philadelphia, Pittsburgh, San Francisco, Portland

A DIVISION OF
AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT, CONNECTICUT



Gulf Parvis Oils

provide the greater protection your Diesels need now!



Wear, repairs, and operating costs go down to rock-bottom levels with these stable lubricating oils in service

Says the Superintendent of a municipal power plant, as noted in Diesel Progress: "We now give lubricants more consideration than formerly since greater demands are placed on the equipment due to increased loads. Units which ordinarily carried normal loads now carry full loads and in some cases overloads, thus causing higher operating temperatures."

Hundreds of operators insure greater protection for their Diesels under today's operating conditions by turning the lubricating job over to Gulf Parvis Oils. Especially manufactured for Diesel engine lubrication, these quality oils have greater stability and higher lubricating value—they stand up and provide a tough film that is a constant safeguard against excessive wear, shutdowns, and high maintenance expense.

For full protection and higher operating economy in *your* plant, take this step today: Call in a Gulf Lubrication Service Engineer and ask him to recommend the proper grade of Gulf Parvis Oil to fit your particular requirements. His thorough training and broad experience with all types of Diesel engines is your assurance of sound and helpful recommendations.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION
GULF REFINING COMPANY
Gulf Building, Pittsburgh, Pa.

How to Get More Life From Worn-out Boilers

If they can pass inspection and a hydrostatic test, APEXIOR will "peg" that condition for more years of good performance.

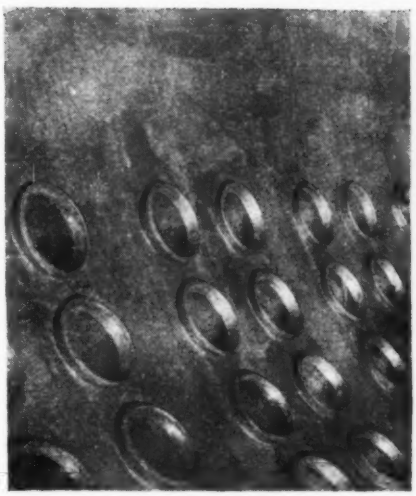
Those boilers nearing the end of their life . . . those boilers already on the inactive list — there's an excellent chance you can get more years of work out of them by APEXIORIZING.

Any boiler that can withstand the required hydrostatic pressure is good for plenty of hard service — if the test strength of the metal is maintained by a durable coating of APEXIOR.

APEXIOR PREVENTS CORROSION FOR 2-3 YEARS

APEXIOR is brush-applied, by hand or power-coater. It fills in the metal pores and joints and forms an impenetrable barrier against water. There is less adherent scale, so scale removal is made easy (with a wire brush) . . . and less often required.

Hundreds of operators have used



APEXIOR for years as an economical means of boiler maintenance. Hundreds more have recently adopted APEXIOR as a guarantee of longer life for metal that cannot be replaced.

An APEXIOR coating will last 2 or 3 years, often longer. It is easily renewed. Save *your* boiler metal from wear and damage that cannot be measured in dollars. APEXIORIZE — and keep boiler metal young.

Easy to Apply — Easy to Maintain — Bulletin 1290 Gives Facts on a Paint that Gives Metal New Life.

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Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Honolulu, T. H., Marine Dept., 114 Liberty St., New York, N. Y.

Users like these have applied APEXIOR for years.

APEXIOR will help YOU get more service from irreplaceable equipment.

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Westinghouse Elec. & Mfg. Co.
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A PEACETIME PLUS · · · A WARTIME MUST

APEXIOR REG. U.S. PAT. OFF.

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

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protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

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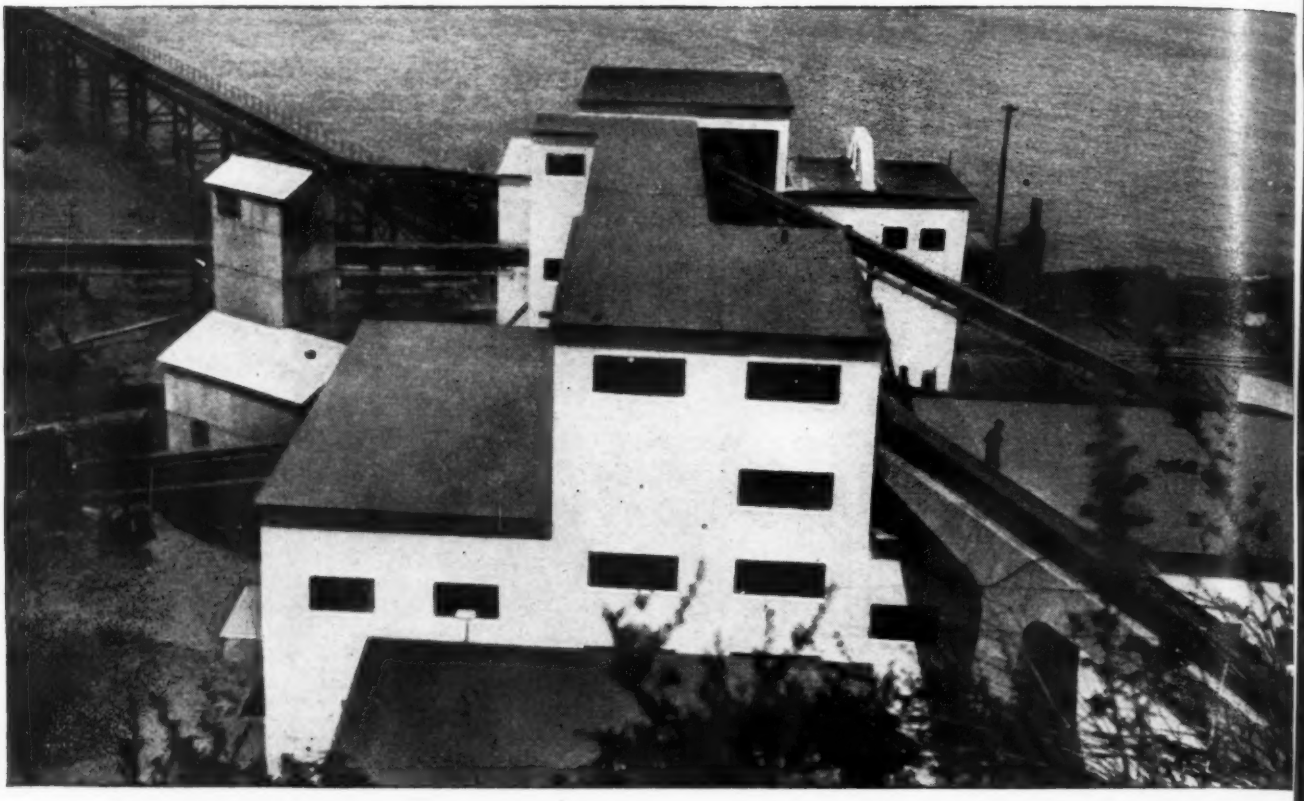


A COMPLEX CONVEYOR SYSTEM *MADE SIMPLE*

by thorough engineering

In Coronel, Chile, a highly intricate and elaborate conveyor system was recently completed . . . designed and manufactured by Robins.

The materials handled include coal and rock. Sub-surface coal mining is carried on 1,200 feet below the earth's surface and extending 2¼ miles out under the sea. At this level, the mined material is brought to a central dumping station by a train of fifty 2-ton cars. The cars are automatically upturned, dumped, contents weighed and righted by a Robins Car Dumper . . . *without uncoupling the cars.*

The material falls into a Track Hopper leading to a Shaking Feeder which delivers it, at uniform rate, to the first of a series of 8 conveyors, one of which is 3,880 feet long—the aggregate of all being more than two miles long extending up to and along the earth's surface.

The last of these conveyors delivers the material to a screening station. Here fines and refuse are removed and the coal is sized on a series of Robins *Gyrex* Screens. The fines and segregated sizes are then conveyed to storage or to railroad cars or to ships, as desired—in any combination of fines and sizes. When delivered to ships, the material travels along a 1,000-foot Dock Conveyor to reach a Shuttle Conveyor which is mounted in a hinged cradle so that the loading operations may accommodate changing tides and diverse drafts of ships.

This installation indicates how Robins engineering overcomes complex problems—reducing them to an efficient, ingenious, simple series of operations. Perhaps you are faced with a difficult conveyor problem. Your inquiry is welcome. Write Dept. P-10 for full details and, if you like, summarize your problems and requirements. We can work directly with you or collaborate with your own engineering consultants.

ENGINEERS • MANUFACTURERS • ERECTORS

ROBINS CONVEYORS INCORPORATED

Founded in 1896 as Robins Conveying Belt Co.

PASSAIC • NEW JERSEY

MATERIALS HANDLING MACHINERY

ROBINS *makes:* BELT CONVEYORS • COAL AND ORE BRIDGES • BUCKET ELEVATORS • CAR AND BARGE HAULS • CAR DUMPERS • CAR RETARDERS • CASTINGS • CHUTES • CONVEYOR IDLERS AND PULLEYS • CRUSHERS • FEEDERS • FOUNDRY SHAKEOUTS • GATES • GEARS • GRAB BUCKETS • PIVOTED BUCKET CONVEYORS • VIBRATING SCREENS • SCREEN CLOTH • SELF-UNLOADING BOAT MECHANISMS • SKIP HOISTS • STORAGE AND RECLAIMING MACHINES AND SYSTEMS • TAKEUPS • LOADING AND UNLOADING TOWERS • TRIPPERS • WEIGH LARRIES • WINCHES • WINDLASSES

FOR MATERIAL AID IN MATERIALS HANDLING . . . . . It's ROBINS

MANY STANDARD FEATURES OF TODAY'S SURFACE CONDENSERS WERE

ROSS

Innovations

Throughout the industry, many standard features of today's Surface Condensers were first introduced by Ross.

Such Ross leadership in engineering and construction dates back many years. As a specific example, take the development of all-welded steel construction, now standard amongst Surface Condenser manufacturers. Ross engineers pioneered it in 1929 when they were the first in this country to build an all-welded steel Condenser for land service. It was most logical for Ross to be the "first" because of its leadership in the practice of fusion welding. An editorial in Power magazine, Nov. 19, 1929, is a document to this well known Ross innovation.,

The most conclusive proof of the success of this and subsequent Ross pioneering efforts is their general and permanent adoption as "standard" by the industry.

What does this mean to the buyer? Simply this: specifying Ross is assuring tomorrow's Surface Condenser TODAY, together with the knowledge and confidence that it represents the best obtainable in engineering design and construction.

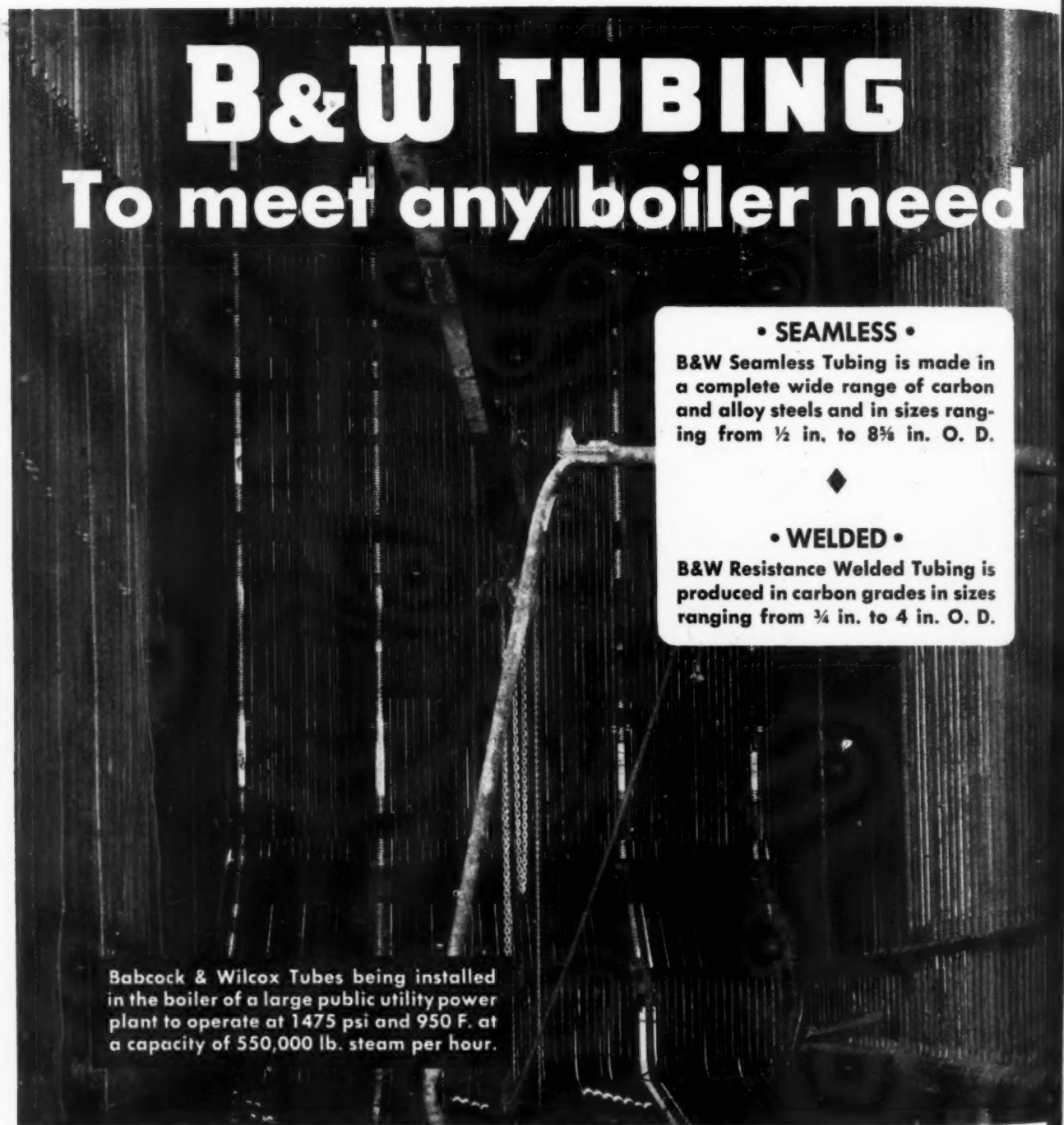
Manufacturers of All Kinds of Heat Exchangers for over a Quarter Century

ROSS HEATER & MFG. COMPANY, INC.

Division of American Radiator and "Standard" Sanitary Corporation

MAIN OFFICE AND PLANT 1807 WEST AVENUE BUFFALO 1, N. Y.

B&W TUBING
To meet any boiler need



• SEAMLESS •

B&W Seamless Tubing is made in a complete wide range of carbon and alloy steels and in sizes ranging from ½ in. to 8⅝ in. O. D.

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• WELDED •

B&W Resistance Welded Tubing is produced in carbon grades in sizes ranging from ¾ in. to 4 in. O. D.

Babcock & Wilcox Tubes being installed in the boiler of a large public utility power plant to operate at 1475 psi and 950 F. at a capacity of 550,000 lb. steam per hour.

Whatever requirements you have for boiler tubes The Babcock & Wilcox Tube Co. can meet your specifications. B&W engineers, backed by more than twenty years' experience in the manufacture of tubes, plus modern, expanded production facilities, are always at your service for advice on your requirements —either for new designs or for maintenance.

★ BACK THE ATTACK— BUY MORE WAR BONDS! ★

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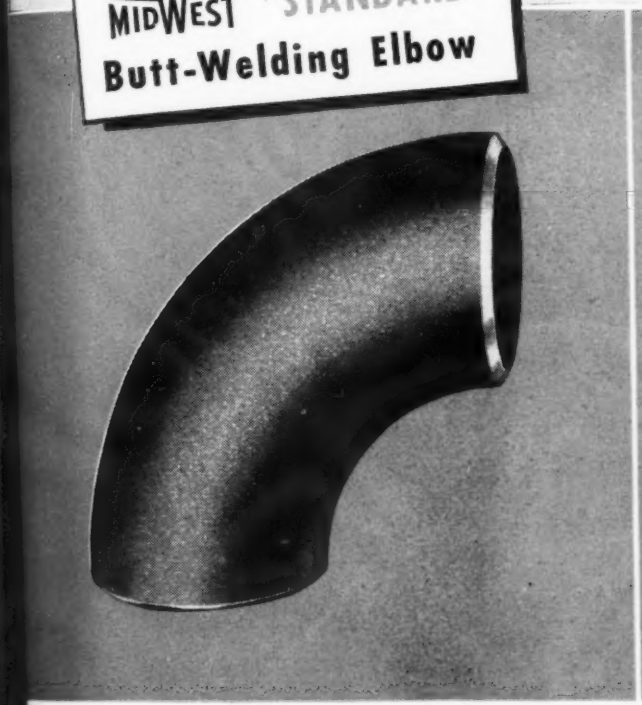
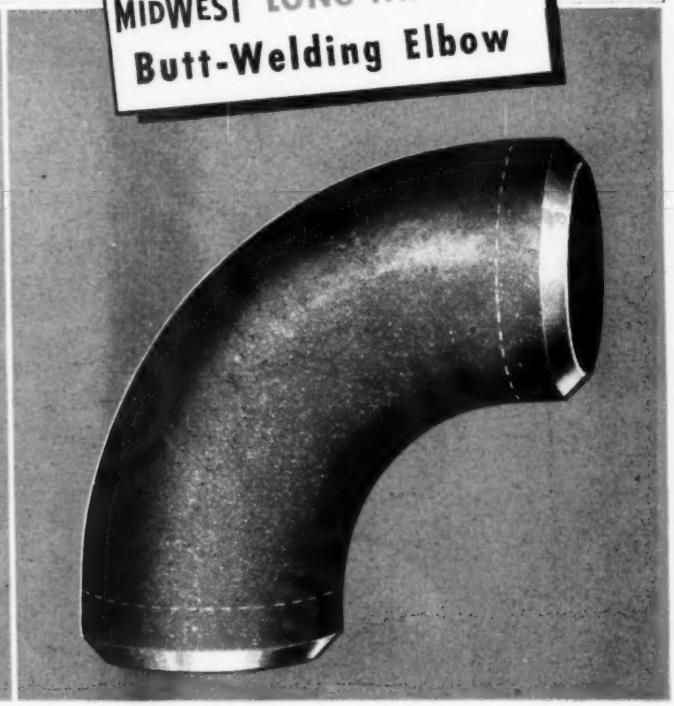
TA-

Only MIDWEST
OFFERS YOU THIS CHOICE

MIDWEST "STANDARD"
Butt-Welding Elbow



MIDWEST "LONG TANGENT"
Butt-Welding Elbow



The difference between the two types of welding elbows shown above is in their dimensions. The "American Standard" elbow has a center-to-end dimension equal to one and one-half times the nominal pipe size. The Midwest "Long Tangent" elbow has tangents (straight ends) equal to one-fourth of the nominal pipe size; the center-to-end dimension is one and three-quarters times the nominal pipe size. Important among the advantages of the long tangents are: (1) pipe and fitting more quickly and accurately lined up, (2) weld removed from point of maximum bending stress, (3) less pipe required, (4) short nipple and extra circumferential weld frequently eliminated, (5) slip-on welding flanges easily used, etc. There is no increase in price for Midwest "Long Tangent" Welding Elbows.

Both types of elbows have all other advantages that result from the unique Midwest manufacturing process: final working of metal in compression (which means exceptional dimensional accuracy and uniformity), stress relieving, exact included angle, true circular cross-section and uniform wall thickness. For all the facts about Midwest Welding Fittings, ask for Bulletin WF-41.

MIDWEST PIPING & SUPPLY CO., INC.

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NAVCO PIPING

NATIONAL VALVE & MFG. CO., Pittsburgh, Pa.

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Shown on the screen of this "Shadow-Mike" is a thread-cutting plug element, being checked for angle and lead of thread. Such gages are used to check the bolt-hole threads in marine turbines and reduction gears which are now being produced by Hendy.

NO MARGIN FOR ERROR

Building massive engines, delicately balanced marine turbines and quiet running reduction gears requires a degree of precision and skill that leaves *no margin for error*. Here at Hendy we magnify small details to gigantic proportions, to make certain that Hendy powered ships reach their destinations with no preventable engine failure.

That's why skilled craftsmen check the measurements of intricate parts with super-accurate gages and, in turn, these gages are checked to five ten-thousandths of an inch in a temperature controlled gage inspection room.

Combining high standards of precision with mass production methods Hendy provides the Pacific Coast with an organization competent to build a wide variety of massive units in volume... for war now... for peace later on.

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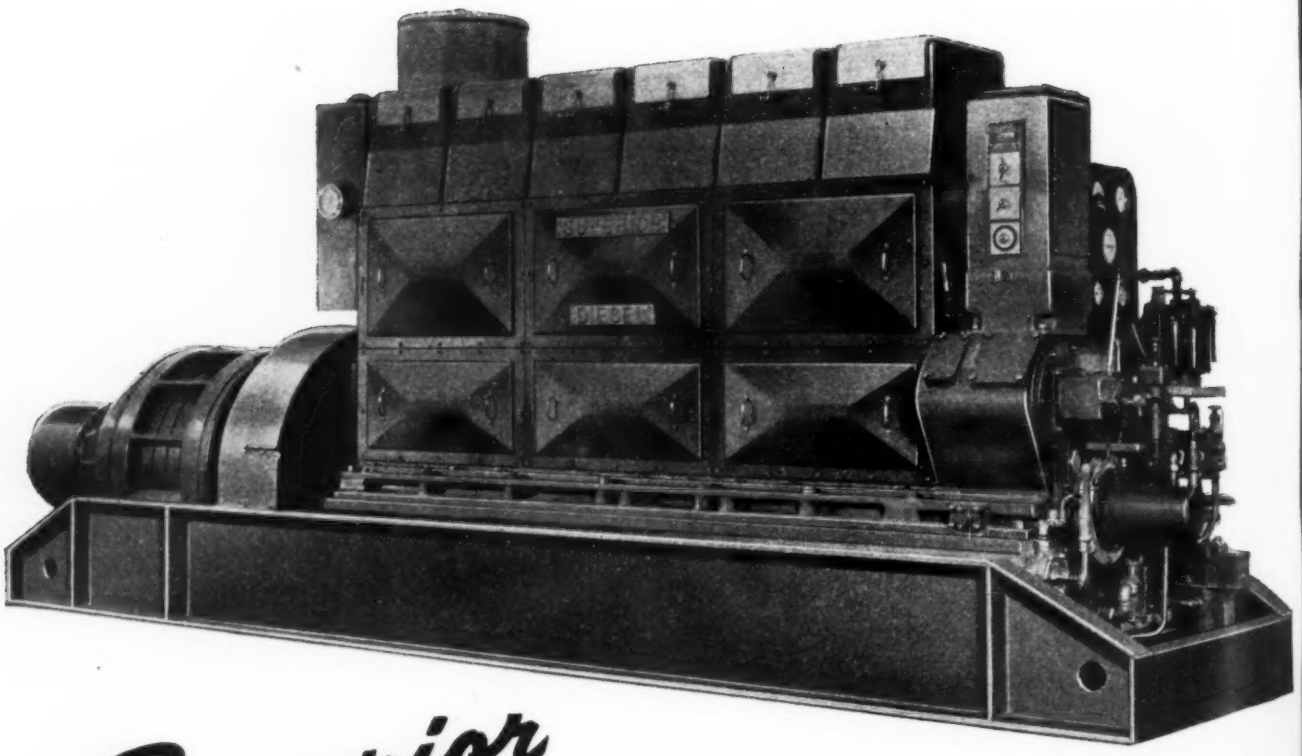

6 cylinder, 260 H. P., 600 R.P.M., 9" x 12" Stationary Engine with Generator

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In engineering, in manufacture and in performance, Superior Diesels have always exceeded the claims advanced for them.

They have been tested in every conceivable type of power installation. Never have they failed to demonstrate the dependable and economical power for which they are famous.

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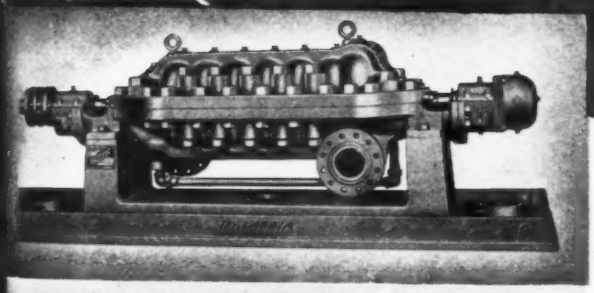
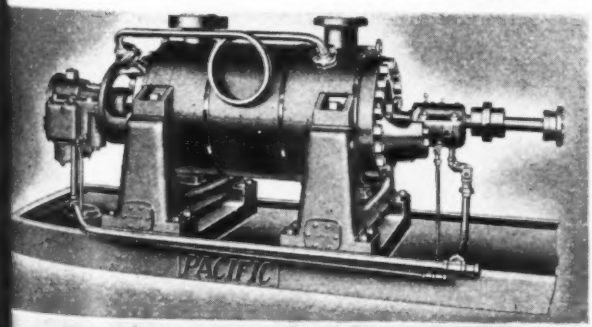
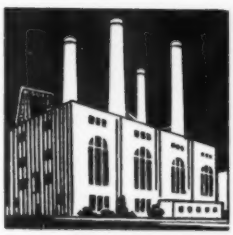
designs and builds the correct types of pumps for all fluid handling needs in the utility field



PACIFIC Type JH—7-Stage Boiler Feed Pump installed by a large municipality.



PACIFIC Type IMB—Multi-Stage Boiler Feed Pump installed by a leading Mid-West Utility.



What are the variables in your pumping operations? What are the general conditions that surround your pumping requirements? How can you obtain the highest pumping efficiency thru the application of the right pump—for the specific job? These are questions on which you want correct answers.

Pacific Pump Works engineers and builds *many major lines of pumps in all standard sizes.* This wide range of pumps was developed to meet your exact needs, no matter where you are operating, or under whatever variables your pumps are encountering.

Want to know *exactly* the correct pump to use for each of your particular pumping conditions? Give the facts to a Pacific representative or service engineer. Consistent with manpower and material availabilities, you will be given full data on the pump or pumps you need. They will also tell you frankly what priorities are required, what deliveries can be made.

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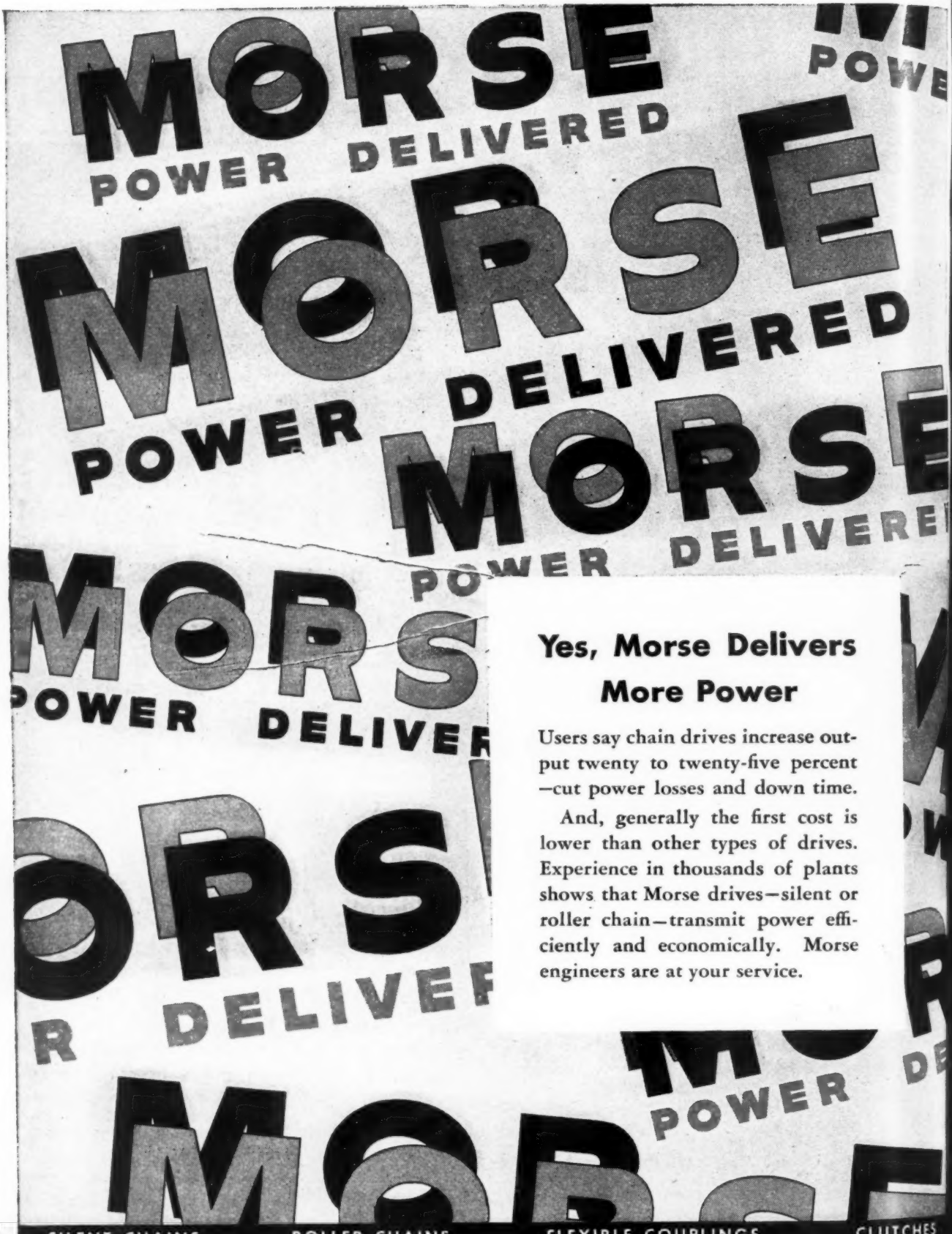
PACIFIC *Engineered* PUMPS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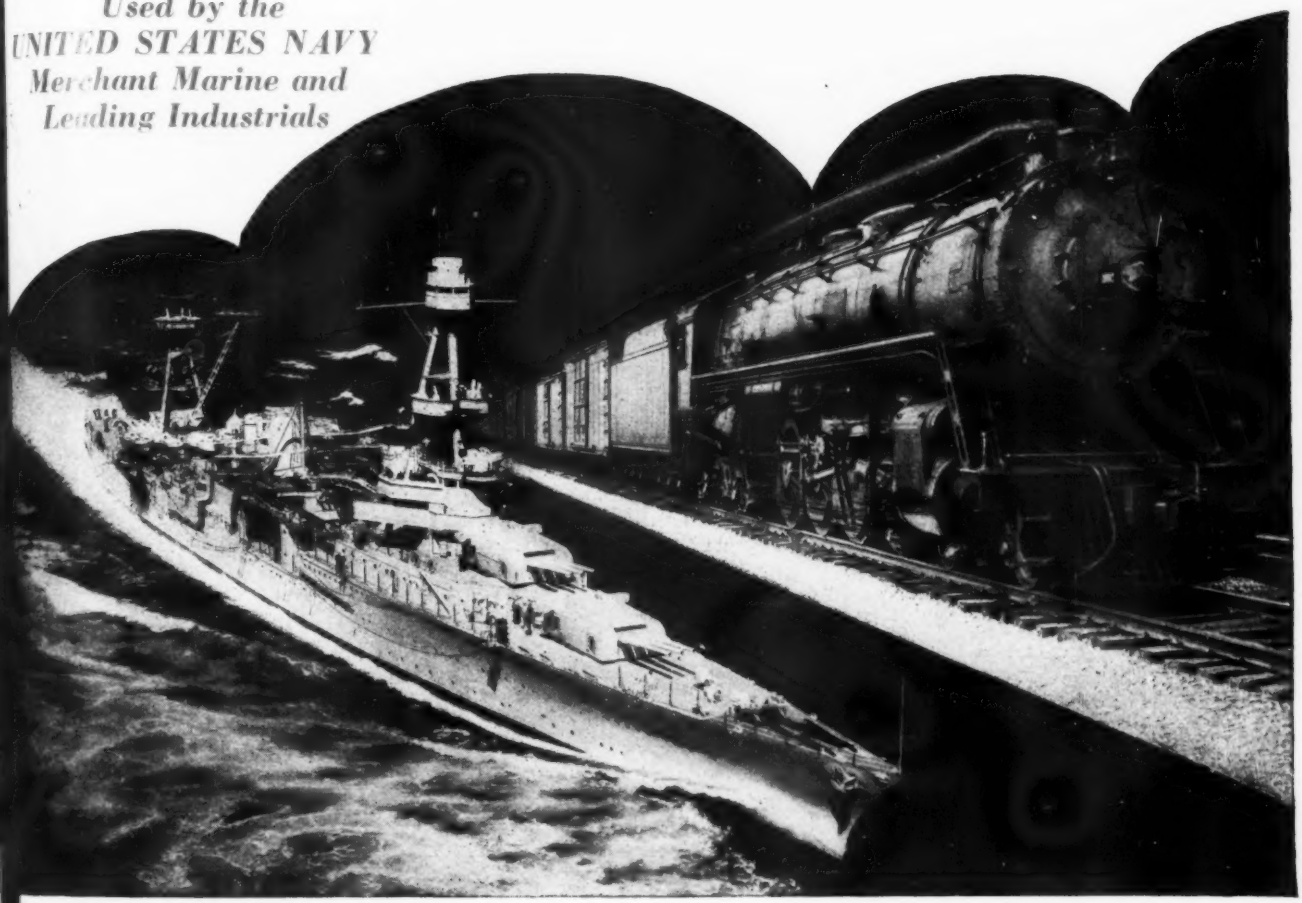
THE UNEXCELLED

COPALTITE

PLASTIC GASKET AND PIPE THREAD COMPOUND

Used by the
UNITED STATES NAVY
Merchant Marine and
Leading Industrials



COPALTITE Applications and General Uses

Turbine joints and flanges.
Hot oils under pressure.
Aeroplane connections.
Boiler manhole and handhole covers.
Alcohol and vinegar lines.
Removable valve seats.
Gasoline and oil joints.
Sealing pumps, compressors, soot blowers and internal combustion engines.
Sealing gauges and instruments.
Flanges without gaskets.
Combustion control systems.
Ammonia and Freon joints.
Propane and Butane gas connections.
All threaded and flange joints holding water, steam, oil, ammonia gases and refrigerants under all pressures and temperatures.

COPALTITE is in service on lines carrying 10,000 lbs. pressure, and on flanges without gaskets holding 800 lbs. superheated steam pressure. Copaltite joints may be easily taken apart after long periods of service.

LIQUID FORM ***for smooth, highly machined surfaces, or as pipe thread compound.***
CEMENT (PASTE) FORM ***for rough surfaces, warped flanges or unfinished parts.***

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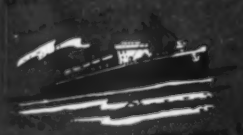

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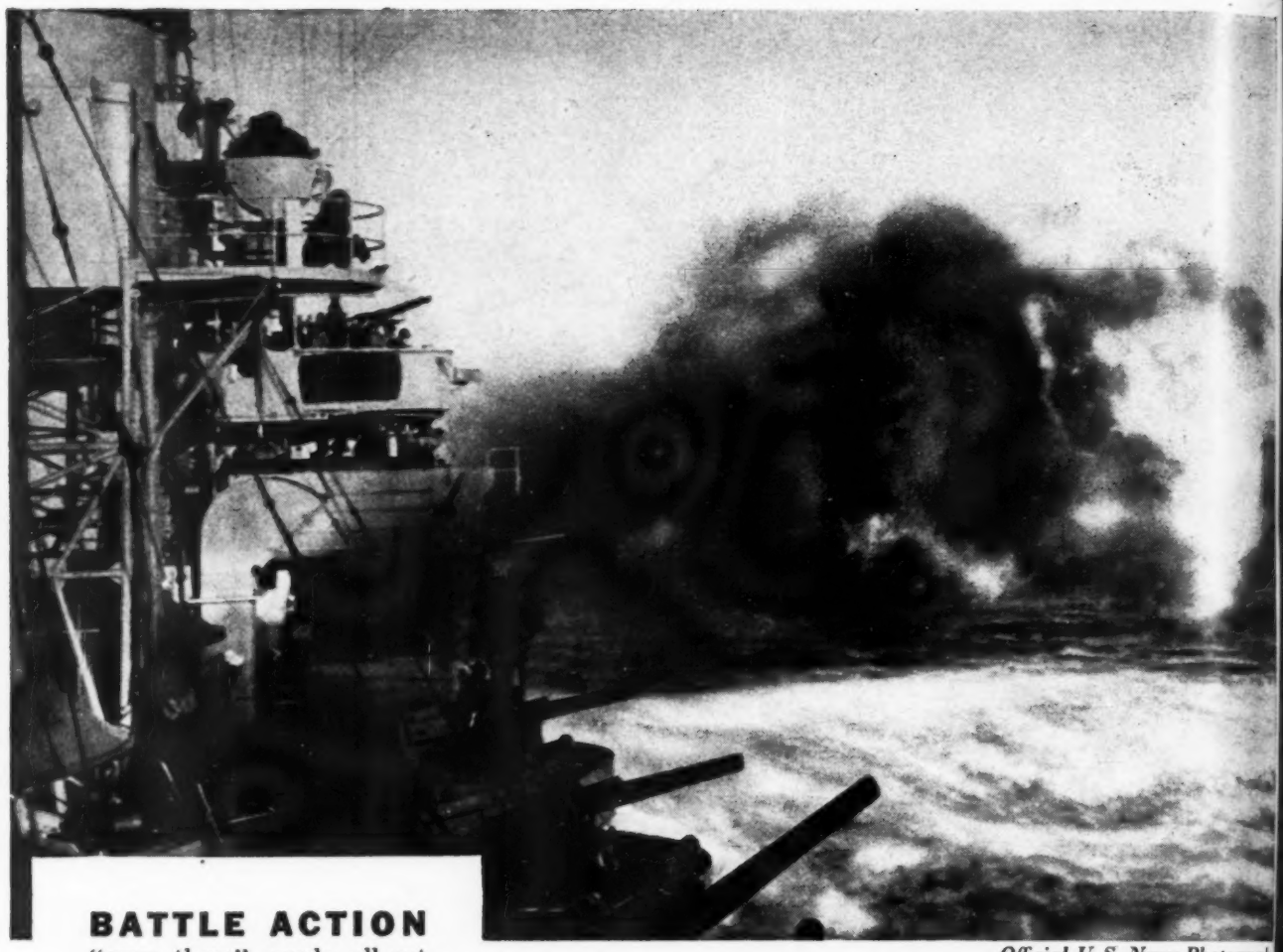
"Big Inch" pipe line was streamlined from lush Texas to oil-starved East in less than a year . . . does the job of 150 tankers . . . faxed the subs . . . thanks to oil men's re- course to Arc Welding.

Look out for 50-mile-to-the-gallon autos . . . new machines at startling prices . . . truck- smashing efficiencies . . . war- developed duplicators . . . new hushed . . . no end of jobs in smart plants (where recourse to Arc Welding is the rule).

Recourse: According to Webster, *"a going to for aid or protection"*



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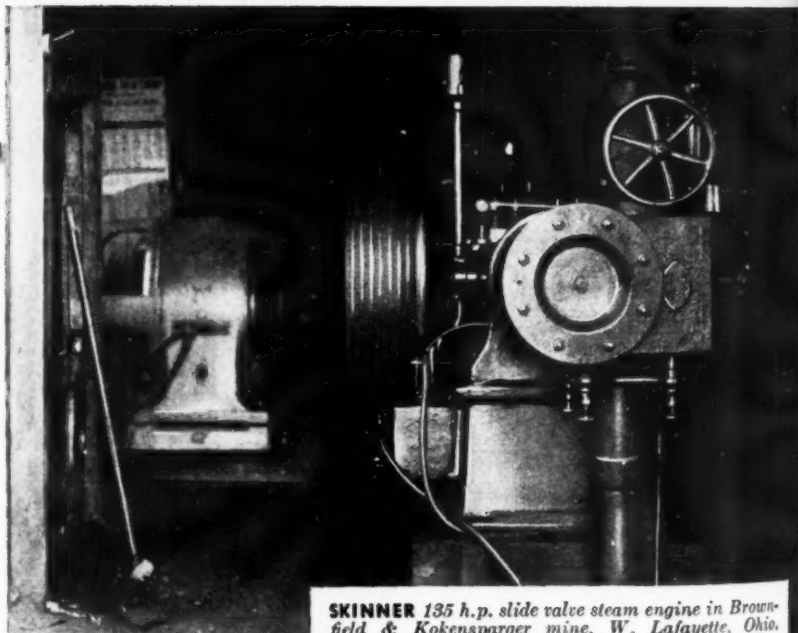
BATTLE ACTION "over there" needs all-out *STEAM* plant support here. To maintain full designed engine output use . . .

. . . SINCLAIR STEAM CYLINDER and VALVE OILS. These oils are suited to high, low, or moderate pressures and temperatures and varying engine characteristics. They atomize quickly . . . give *safe* lubrication under all load conditions.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.



SKINNER *135 h.p. slide valve steam engine in Brownfield & Kokensparger mine, W. Lafayette, Ohio. Sinclair oils used with "very satisfactory results."*

SINCLAIR INDUSTRIAL OILS

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Temperature ZONED for Industrial Needs

WHEN your building is equipped with an M-H Zone Control System, you provide exactly the degree of temperature necessary for all conditions *without wasting fuel.* You compensate for the effects of outside weather, exposure, and the construction of your building, and the time and kind of occupancy. Zone Control may be provided by inside Thermostat control, outside Weatherstat control or individual radiator control. Bulletin Z 1 explains. Write for your copy. Minneapolis-Honeaywell Regulator Co., 2702 Fourth Ave. South, Minneapolis 8, Minnesota.

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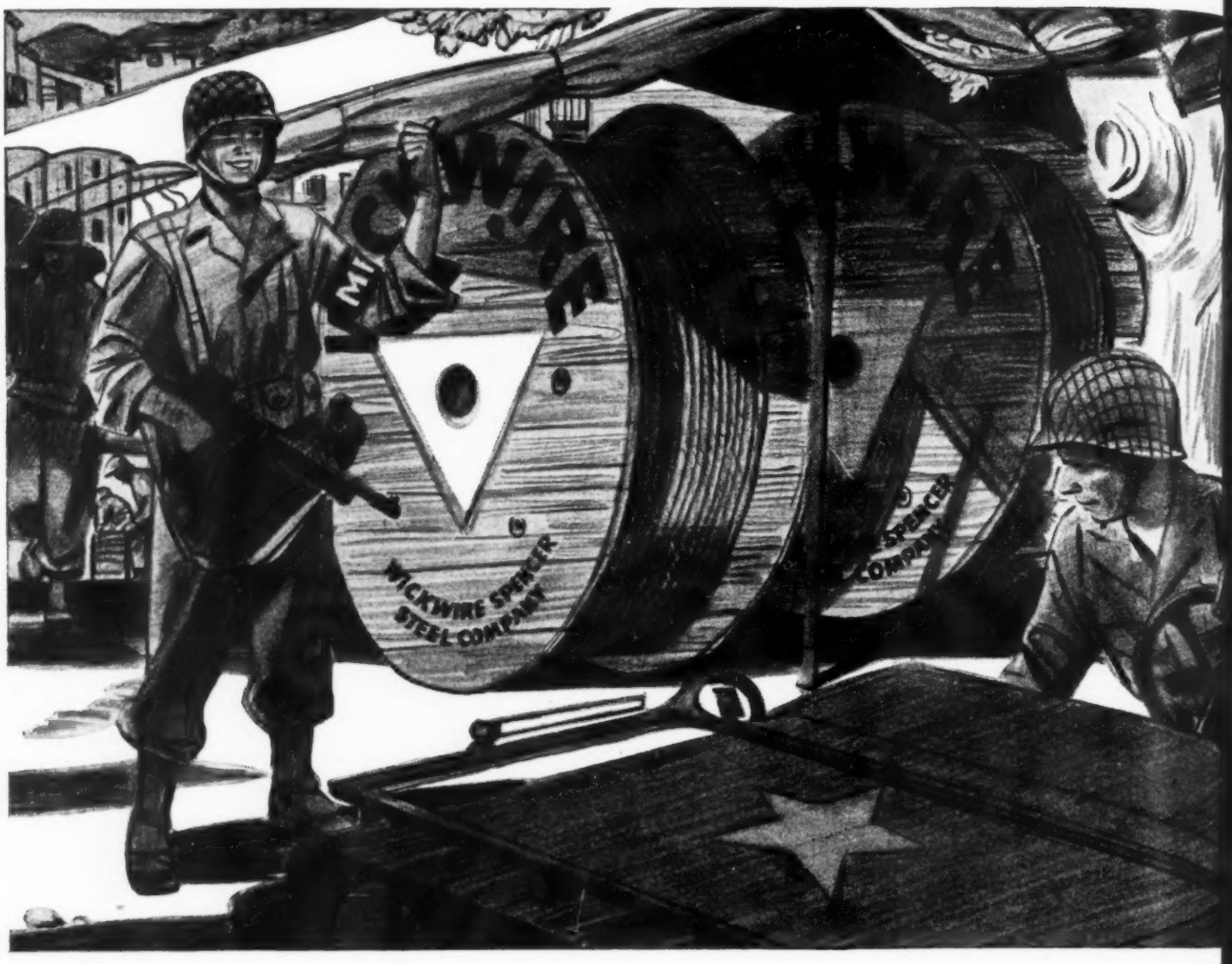

"It's here to do a job, Pal—and soon!"

"We can't get along without plenty of that *friendly* wire rope. What does it do? Just stick around, soldier—and how do you think that souped-up bronco you're running around in got off the boat? Wire Rope!"

The guard is right. It takes a lot of easy-handling wire rope to move the stuff an Army needs. Think of North Africa—think of Sicily! And there has to be *enough* of it!

That's why you and we at home here have to conserve the wire rope *we* use.

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Wickwire Spencer, the first in New England to be awarded the Maritime M and Victory Fleet Flag, has now received the GOLD STAR for maintaining excellence of production.

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Our FREE book, "Know Your Ropes," will tell them. It tells why a sheave that is too small wears out rope fast. It shows how to figure the right size sheave for every diameter of rope . . . and gives numerous other "Life Savers" that will help make your present wire rope last longer. Send for your free copy, today!

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Compressed Air for automatic control

The increasing application of pneumatic control is recognition of its many advantages—reliability, simplicity, safety, and ease of maintenance. Automatic pneumatic control is one of the cornerstones of continuous processes, and without it many process industries could not operate.

Here is another striking example of the utility of compressed air power. It may suggest to you a means of solving many of your problems by applying air—the power medium for countless jobs which cannot be done as well, if at all, by any other method.

Ingersoll-Rand has pioneered compressed air systems since 1871, always supporting and developing new and time-saving applications. Our engineers will be glad to cooperate with you. Ingersoll-Rand Co., 11 Broadway, New York, N.Y.

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STEAM PRESSURE REDUCING VALVE

● Varying flow demands won't affect terminal pressure . . . nor will downstream pressure build up under no service consumption, if your lines are equipped with the G-A Steam Pressure Reducing Valve. Due to perfectly balanced pilot valve operation, sensitive downstream pressure is maintained and single seated main valve design prevents pressure increase on "dead end" service.

The G-A Steam Pressure Reducing Valve is furnished in sizes ranging from 2½" to 12" . . . Double Extra Heavy Cast Iron construction with semi-steel or cast steel body and bonnet. Trim may be Bronze, Monel Metal or Stainless Steel. Valve efficiently handles 125 lbs. to 400 lbs. of saturated or superheated steam.

Write today for your free copy of the latest G-A catalog . . . it contains detailed construction and application data on the complete line of Golden-Anderson Specialty Valves.

Also

Altitude Control . . . Throttle and Emergency Stop . . . Check . . . and other types of valves.

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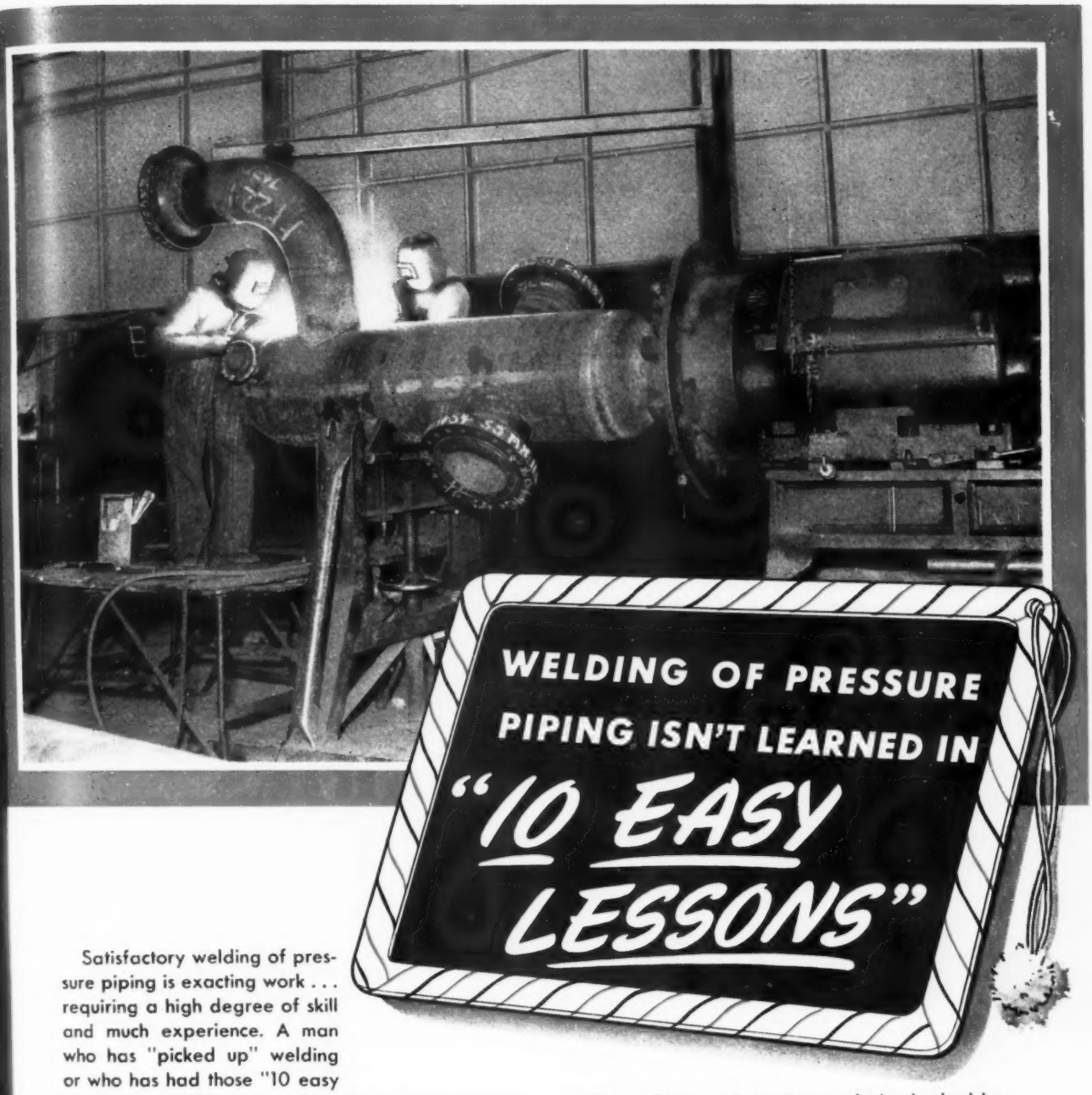
GOLDEN-ANDERSON VALVE SPECIALTY COMPANY

FULTON BLDG. • PITTSBURGH, PENNSYLVANIA



Satisfactory welding of pressure piping is exacting work . . . requiring a high degree of skill and much experience. A man who has "picked up" welding or who has had those "10 easy lessons" cannot be expected to do pressure piping work that will pass inspection.

Welders employed by pipe fabricators are carefully trained and have plenty of experience before they are entrusted with pressure work. They have passed operator qualification tests and use procedures that have been qualified. They work with the best equipment . . . special rotating fixtures enable them to weld under the most favorable conditions. Their work is also regularly checked by laboratory tests.

Pre-fabricated piping comes to you in a series of subassemblies with all difficult operations performed. These subassemblies are commercially practical, heat treated and stress relieved when necessary, shop tested, accurately aligned, thoroughly cleaned and inspected. Erection requires a minimum of time and labor; the finished job is better piping.

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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are *helping hands* for any Diesel!

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These husky workers are literally "Helping Hands" to every Diesel operator, and pour out their tremendous reserves of power at high voltage . . . for faster cranking. Ask the men who know Diesels, ask the U. S. Army or the Navy, and they'll tell you about the dependability and ease of maintenance which is Exide's. Full details are given in Exide's Catalog of Heavy Duty Batteries. Write for it.

Naturally, even the finest and longest-lasting battery must not be abused in war-time. Guard your Exides to make them last longer. You've *Bought to Last*, now *Save to Win*.

BACK THE ATTACK—WITH WAR BONDS

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BUY TO LAST
SAVE TO WIN

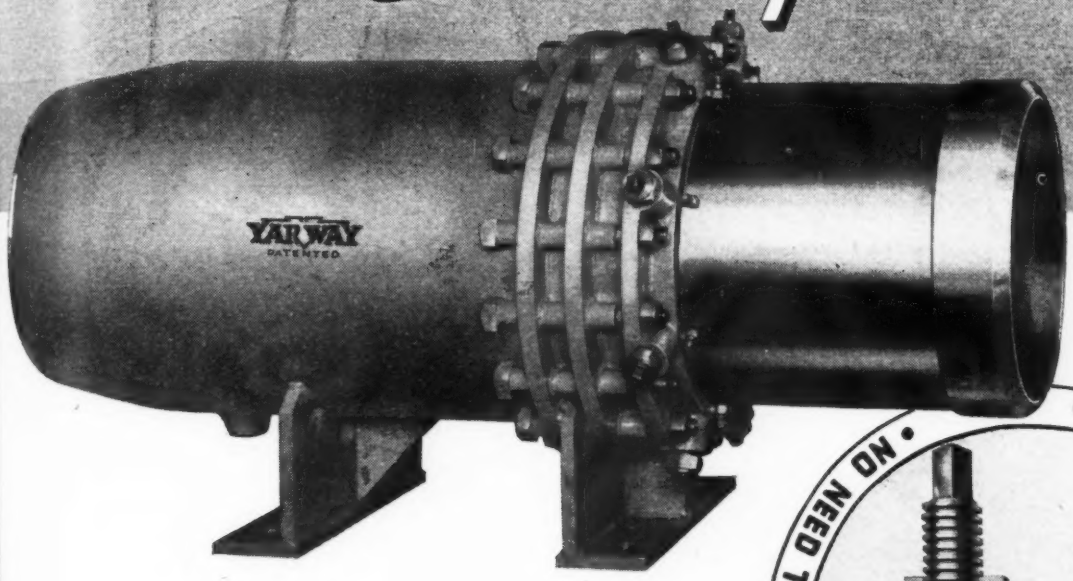
THESE RULES ARE HELPING HANDS FOR BATTERIES:

1. Keep adding approved water at regular intervals. Most local water is safe. Ask us if yours is safe.
2. Keep the top of the battery and battery container clean and dry at all times. This will assure maximum protection of the inner parts.
3. Keep the battery fully charged—but avoid excessive over-charge. A storage battery will last longer when charged at its proper voltage.
4. Record water additions, voltage, and gravity readings. Don't trust your memory. Write down a complete record of your battery's life history. Compare readings.

If you wish more detailed information, or have a special battery maintenance problem, don't hesitate to write to Exide. We want you to get the long-life built into every Exide Battery. Ask for booklet Form 2399.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia • Exide Batteries of Canada, Limited, Toronto

Never Unpacked in Eight Years of Service



Years of experience with thousands of Yarway Gun-Pakt Expansion Joints have established the Yarway as the preference of leading industrials, utilities, institutions and government departments.

For they all have learned that this joint which is packed under full steam pressure and never needs to be unpacked—eliminates repacking shut-downs, saves a tremendous amount of time, trouble, money and hard labor under gruelling temperature conditions, normally required to keep slip-joints tight.

Why don't you investigate the Yarway Gun-Pakt Joint—called "the greatest expansion joint improvement of modern times."

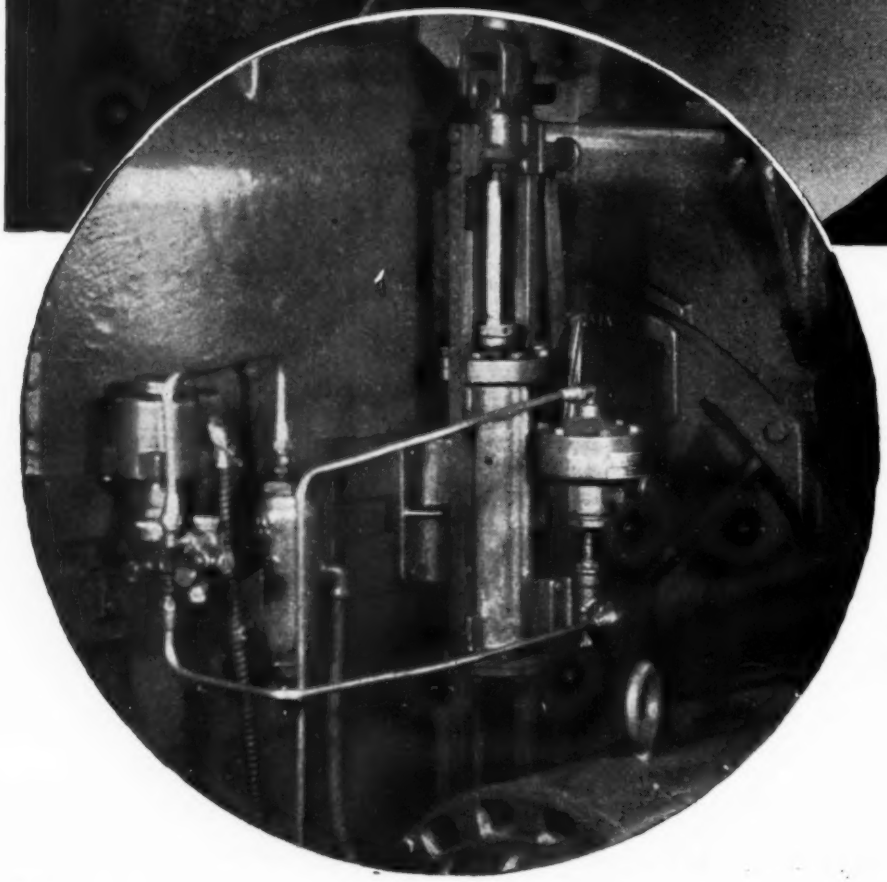
Write for Catalog EJ-1908.

YARNALL-WARING COMPANY
100 Mermaid Ave. Phila. 18, Pa.

The Yarway Gun-Pakt Expansion Joint is the ONLY slip Joint which is packed without unpacking. By a twist of a wrench, a special Yarway semi-plastic packing is forced into the stuffing box by means of integral pressure guns while the joint is under *full steam pressure*. The old packing, rejuvenated by the new, need not be removed.

YARWAY GUN-PAKT EXPANSION JOINT

"Trigger-quick"



STEAM LOADS JUMP ALL OVER THE MAP in this large steel mill, as can be seen from the load and pressure charts. But notice how fast the boilers respond, maintaining pressure within a few pounds.

★ ★ ★

FAST RESPONSE FROM STOKERS is assured by this Hagan Stoker Speed Control which feeds coal at the exact speeds required to furnish the necessary amounts of steam. Note simplicity and accessibility.

response of Hagan Control

gives you MORE STEAM the instant you need it

STEP on the gas in your automobile and you get instant response. If you didn't, you would soon be looking for another car. That's the kind of action Hagan Control brings to your boilers—and it's all automatic.

Big load shifts or small get instantaneous, accurate response to steam demand *when you need it*—not 15 seconds later. War plants need this flexibility of operation and all of them equipped with Hagan Control have it.

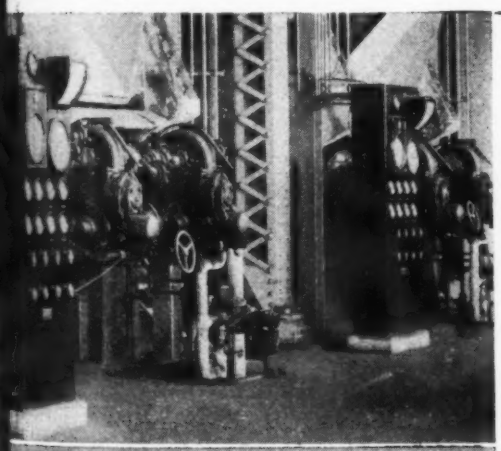
Other factors may vary but Hagan Control is so sensitive to the slightest change in demand, so automatic and independent of human help, so quick in its response, and above all, so dependable, it is one known quantity you can always bank on.

This dependability is only one of the important characteristics of Hagan Control.

Topping even that in importance today is the improvement it makes in steam output. Because, regardless of other means to increase boiler capacity, Hagan Control, by adjusting all auxiliaries for maximum output, will insure the maximum of steam from every pound of fuel.

Why, is no trade secret. It is simply due to exclusive Hagan features of design and operation—the perfection of engineering principles pioneered by the very men responsible for Hagan Control today.

This will be good news to many power plant operators who have been forced through the necessities of war production to ignore measures of economy. While you might make the investment today to pay off in efficiency, there is no question of the dividends you'll get during many years of peace. We would like the opportunity to prove it.



HIGH COMBUSTION EFFICIENCY, even with unskilled operators, is obtained by a Hagan Control system in an industrial power plant. With today's manpower shortage this is a distinct advantage.

HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM UTILIZATION value, uniform steam pressure and temperature, in accordance with demand.

MAXIMUM OUTPUT from boilers of differing capacities, automatically.

MAXIMUM STEAM for production, by reducing loss of steam in frequent soot-blowing.

MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

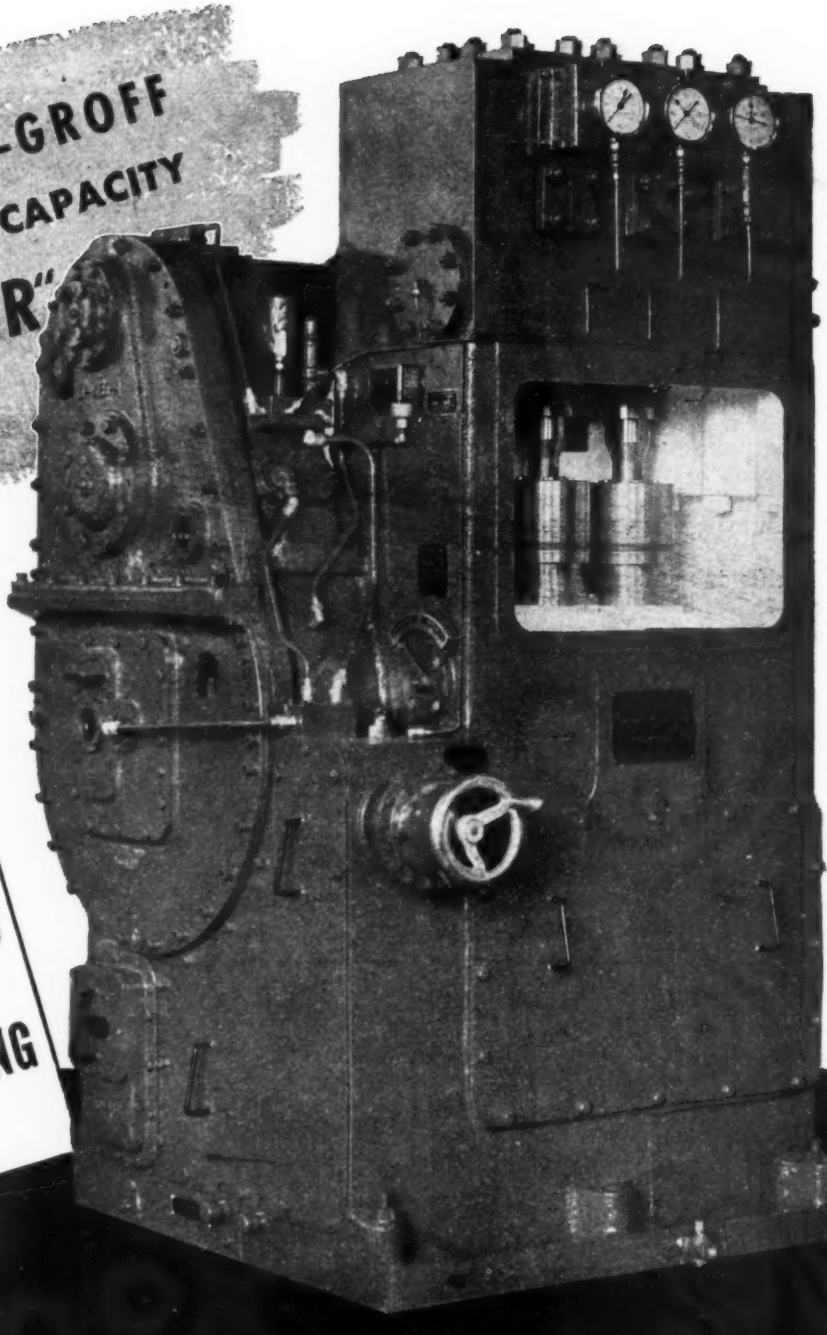
HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

THE ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMP . . .



. . . for MAIN BOILER FEED and DESUPERHEATING SERVICE

Aldrich-Groff Pumps provide for automatic or remote manual control of delivery, from zero to full capacity, at constant pump speed. Rate of delivery is controlled by varying the length of the plunger stroke, and power consumption is almost directly proportional to pump delivery. These pumps combine the positive displacement and high efficiency of the plunger type pump with the flexibility and smoothness of a centrifugal.

The use of these pumps with unit feed systems eliminates the pressure and power losses associated with throttling-type feed-regulating valves. They provide advantages of feed system simplicity, efficiency and mechanical reliability for the small and medium boiler plant using medium and high steam pressures, and for de-superheater feed service in even the largest power stations. Over 100 units in operation on land and sea with outstanding service records.

Write today for the Aldrich Bulletin 65. It gives full details, sizes and ratings of Aldrich-Groff "Powr-Savr" Pumps.

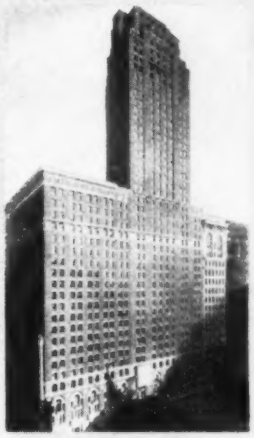
THE ALDRICH PUMP CO. ALLENTOWN, PENNA.

These Companies Don't Buy Electric Power They Generate Their Own, with . . .

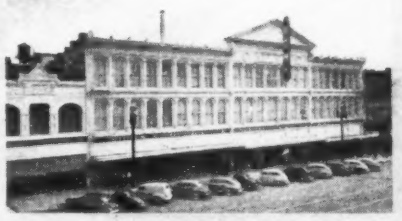
SKINNER "Universal Unaflow" STEAM ENGINES

Large pump manufacturer in Ohio. Two 3-cylinder vertical "UNIVERSAL UNAFLOW" Steam Engines with 3-wire D-C generators, 1000-kw. total capacity. Steam pressure 250 psi., 100° F. s.h., back pressure 0-2 psi. Installed 1930, '37.

Prominent meat packing plant in Cincinnati, Ohio. Three horizontal "UNIVERSAL UNAFLOW" Steam Engines with 3-ph., 60-cy., 240-v. A-C generators. Total capacity 882-kv.a. Also 400-i.hp. engine driving vertical ammonia compressor. Steam pressure 165 psi., 70° F. s.h., 0-2 psi. back pressure. Installed 1923, '27, '35, '36.



Well-known hotel in Chicago, Ill. Two horizontal "UNIVERSAL UNAFLOW" Steam Engines with 3-wire D-C generators, 1500-kw. total capacity. Steam pressure 125-150 psi., sat., 0-2 psi. back pressure. Installed 1925, '30.



Large department store in Salt Lake City, Utah. Three horizontal "UNIVERSAL UNAFLOW" Steam Engines with 3-ph., 60-cy., 240-v., 4-wire A-C generators, total capacity 1314-kv.a. Steam pressure 150 psi., 100° F. s.h., 5-7 psi. back pressure. Installed 1939, '41.

Famous military academy in Indiana. Two horizontal "UNIVERSAL UNAFLOW" Steam Engines with 3-ph., 60-cy., 2300-v. A-C generators, 812-kv.a. total capacity. Steam pressure 150 psi., 50-75° F. s.h., 5 psi. back pressure. Installed 1927, '39.

A few of the many purchasers who have given us one or more Repeat Orders.

A Repeat Order Is The Best Evidence of Satisfaction.

ARMY (E) NAVY

Proudly we fly the Army–Navy "E" Flag, awarded for excellence in production

LIKE hundreds of other manufacturers and operators of various types of institutions, the power users shown here have found it more economical to generate their own power with Skinner "Universal Unaflow" Steam Engines than to purchase it from the local utility.

In practically every known industry savings are being effected where far-sighted management is using Skinner engine-generating equipment. Although you may have a seemingly low *rate per kilowatt-hour* for purchased power, it will pay you to investigate, for postwar planning, how much lower your *cost* could be for power generated by Skinner "Universal Unaflow" Steam Engines.

At present we are engaged entirely in building engines for the War Program, but our engineers are always available to discuss planning for the future. Case studies pertaining to your particular industry will be sent upon request.

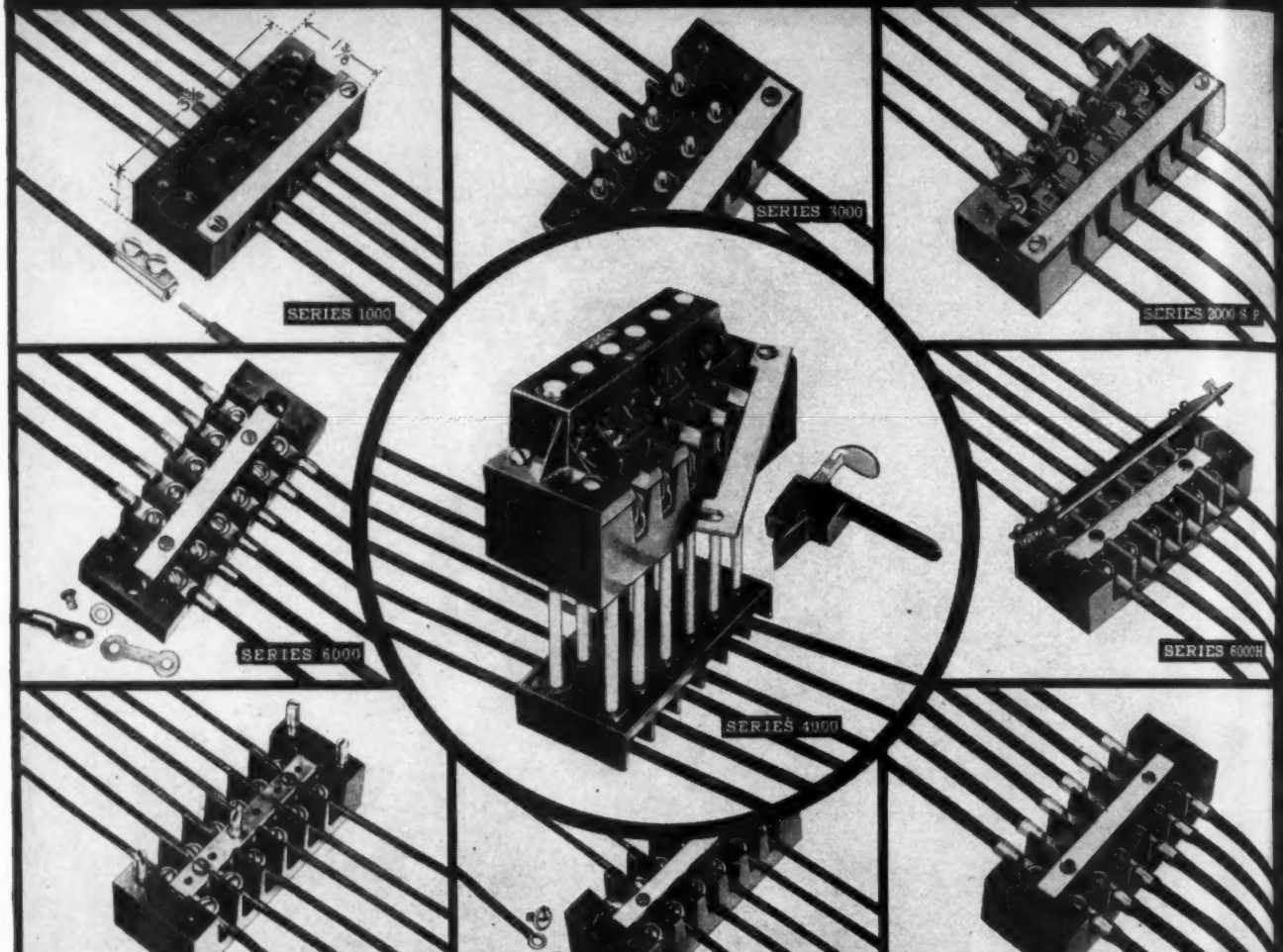
INVEST TODAY IN BONDS FOR VICTORY

Our Seventy-fifth Anniversary

1868 – 1943

SKINNER ENGINE COMPANY FOUNDED IN 1868 **ERIE, PA.**

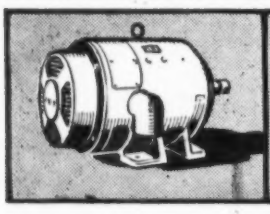
Choose from 10
BURKE TERMINAL BLOCKS

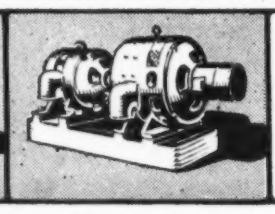


Wherever two or more wires come together there is an application for Burke Controlead Terminal Blocks. They are standardized in 10 types to meet all kinds of applications. Additional moulding capacity on a 24-hour basis permits faster deliveries to meet urgent war demands. Consult with Burke engineers for correct selection of these high quality blocks for your needs.

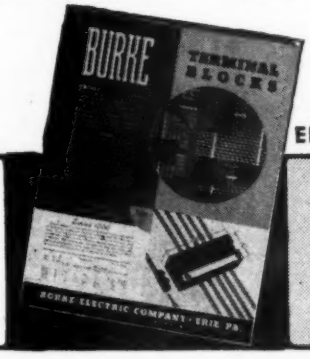
Write for Booklet TB-2 Today

BURKE ELECTRIC COMPANY • 1203 WEST 12TH STREET ERIE, PENNSYLVANIA

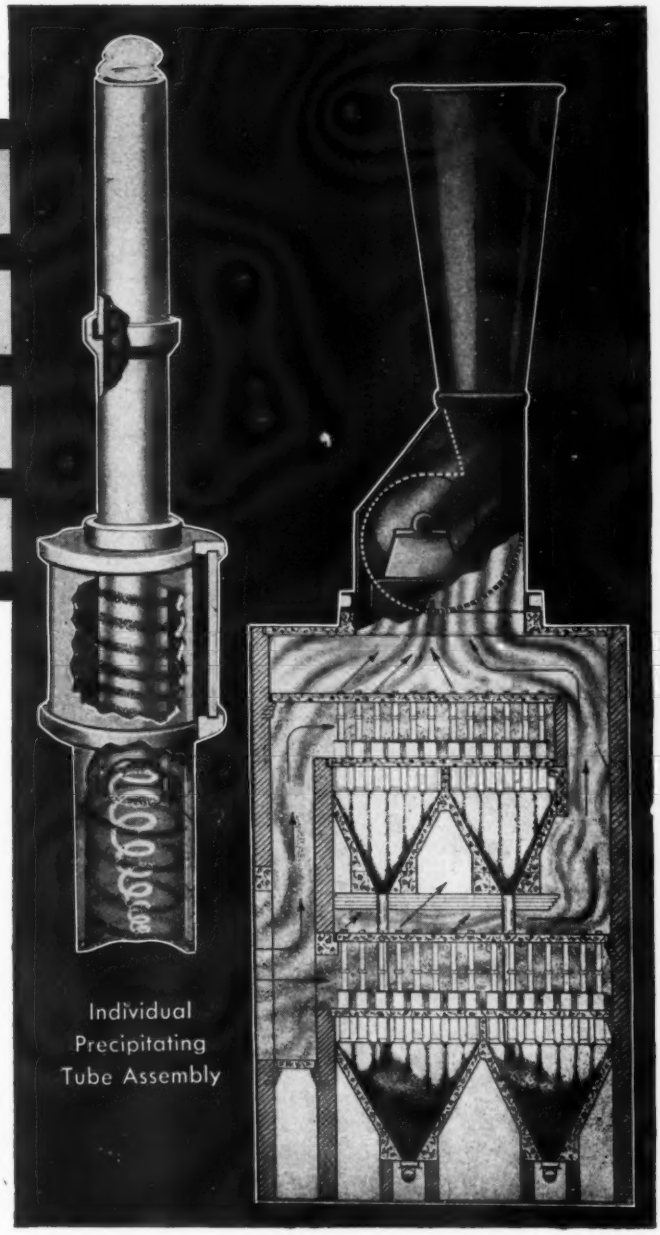




D.C. Equipment to 1500 H.P. and 1000 K.W.
A.C. Equipment to 1500 H.P. and 1000 K.W.
M-G Sets to 1000 K.W.
Molded Bakelite Terminal Blocks



AN IMPORTANT MESSAGE TO THOSE WHO NEED A DUST COLLECTOR NOW



Individual Precipitating Tube Assembly

In these times it is practically impossible to get delivery of a dust collector made of steel—for steel is a fighting material.

But you can get quick delivery *without a priority*, of a Thermix CERAMIC Dust Collector because it is made of materials not needed for the war.

Instead of using steel for the tubes, they are made of fire clay so thick and rugged that they are even harder than steel, yet they weigh no more. Temperature changes and normal handling do not affect them.

In spite of the non-critical materials used, this new Thermix Dust Collector retains all the features which have resulted in the high efficiency of Thermix Steel Dust Collectors now used for the collection of fine dusts, powders and fly-ash in connection with over 40,000,000 lbs. of steam capacity per hour.

Another thing, these improved ceramic tubes eliminate corrosion. They are not affected by low temperature gases containing sulphur and can handle high temperature gases. This Dust Collector can be installed outside of the plant, if desired, without an additional protecting structure.

Write for bulletin and full particulars, or mail the coupon.

PRAT-DANIEL CORPORATION, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities

Thermix Ceramic DUST COLLECTOR

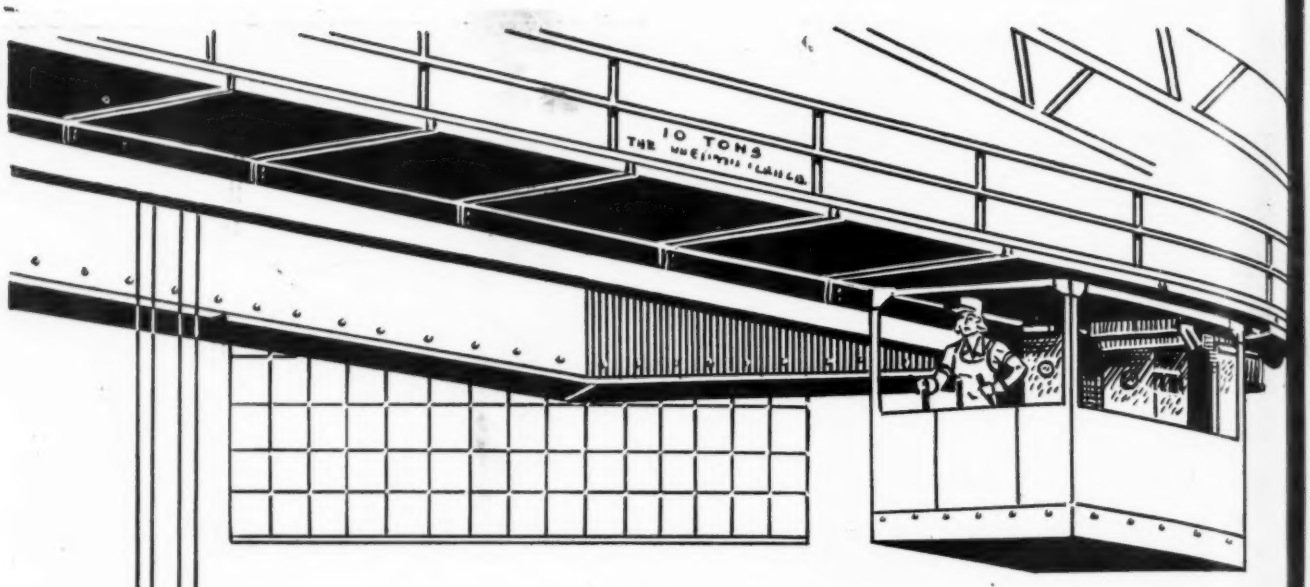
THERMIX ENGINEERING CO.
First Natl. Bank Bldg.,
Greenwich, Conn.

Without obligation on our part, you may send details about the Thermix Ceramic Dust Collector.

NAME .....

ADDRESS .....

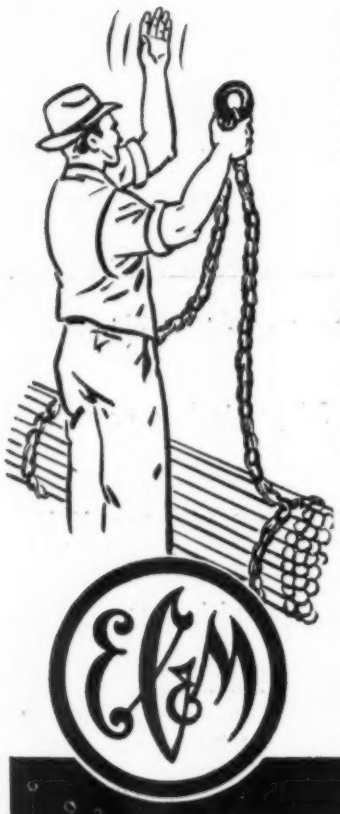
CITY .....STATE.....



"HURRY UP SISTER!"

"I can't—it won't go— Something's the matter with it!"

"I've got the controller-handle full on—and there's plenty of juice."



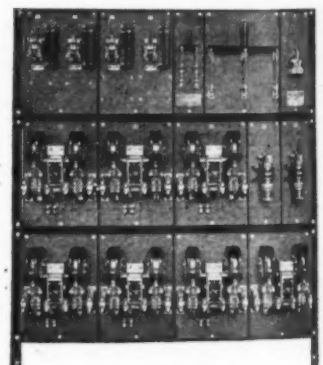
★ That's just the trouble, sister. You've got too much juice and are roasting that a.c. wound-rotor bridge motor. Back the control up toward the off point. That will reduce the current and put the motor-torque up where it belongs and get you going. The only way to handle a wound-rotor motor, operated by manual control, is to notch the control along, step by step, giving the motor a chance to get going between notches.

Now, if you had a magnetic control like the EC&M type, you could throw the master-handle full "on" without trouble, the EC&M Frequency Relays automatically taking care of acceleration and plugging for you.

This control protects the motor, too. For example, one was installed over a year ago on a foundry crane and since then there has not been a minute's delay, while on some of the other cranes in this plant, bridge motors last an average of only three months before they need rewinding.

Today, many carefully engineered cranes are equipped with EC&M Frequency Relay Magnetic Control, complete facts about which are given in Booklet 930. Write for your copy today.

Type of Master Switch used with Magnetic Control. Bulletin 1182, Type NT Master.

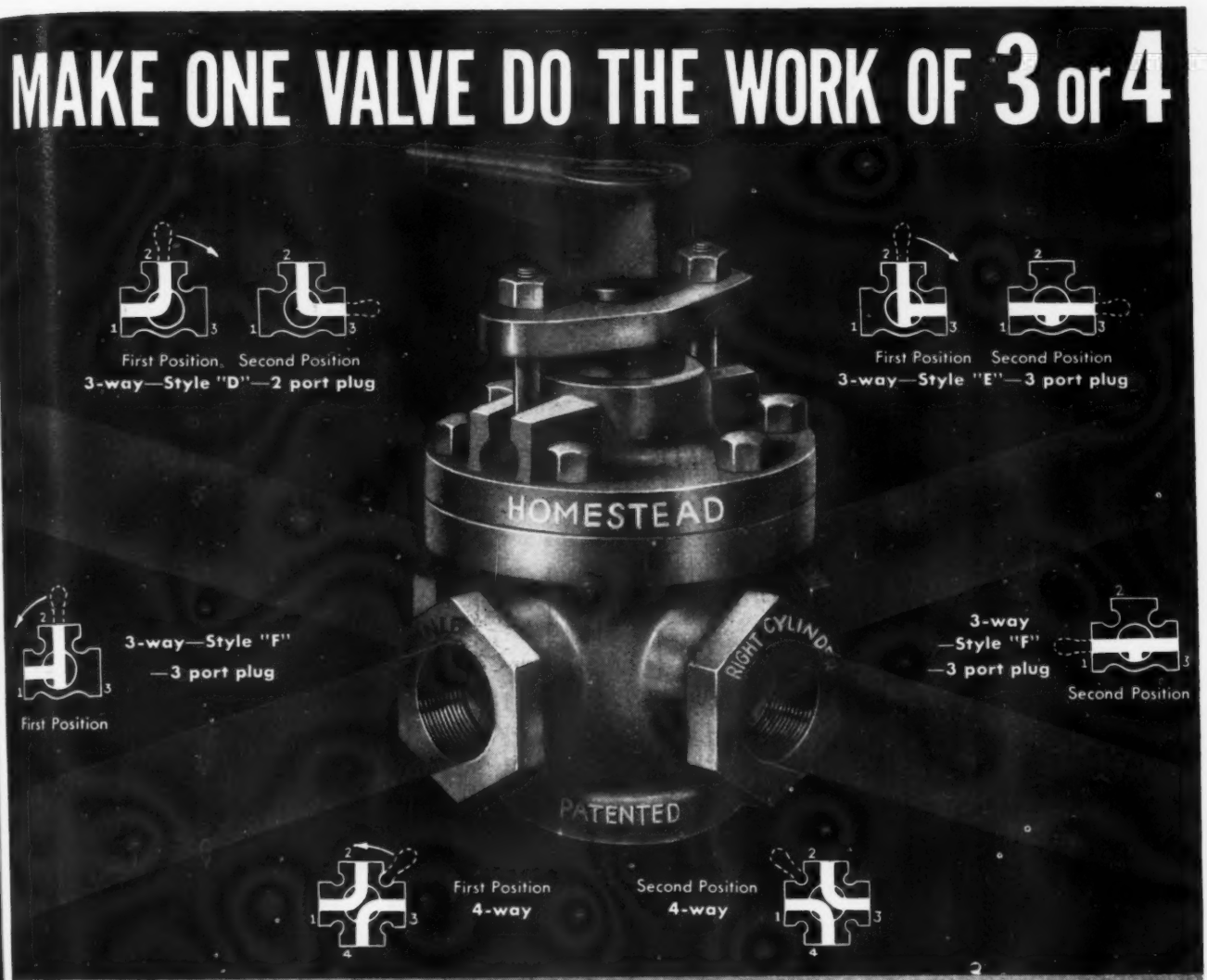


EC&M 37 H.P., 550 Volt A.C. Reversing-Plugging, Frequency Relay Magnetic Controller for Bridge Motion of overhead crane in steel mill.

THE ELECTRIC CONTROLLER & MFG. CO.

2700 East 79th Street ★ Cleveland 4, Ohio

MAKE ONE VALVE DO THE WORK OF 3 or 4



use HOMESTEAD
3-WAY OR 4-WAY VALVES

Because a *single* valve does the work of three or four shut-off valves, Homestead 3-Way or 4-Way Valves save operating time, trouble and expense, when used as fluid "flow changers" or "switching" valves. They are also ideal for use as operating valves to control single or double acting pistons which travel the full length of their stroke. Added savings result from the proved, lower-per-year maintenance cost and longer life typical of "Homesteads."

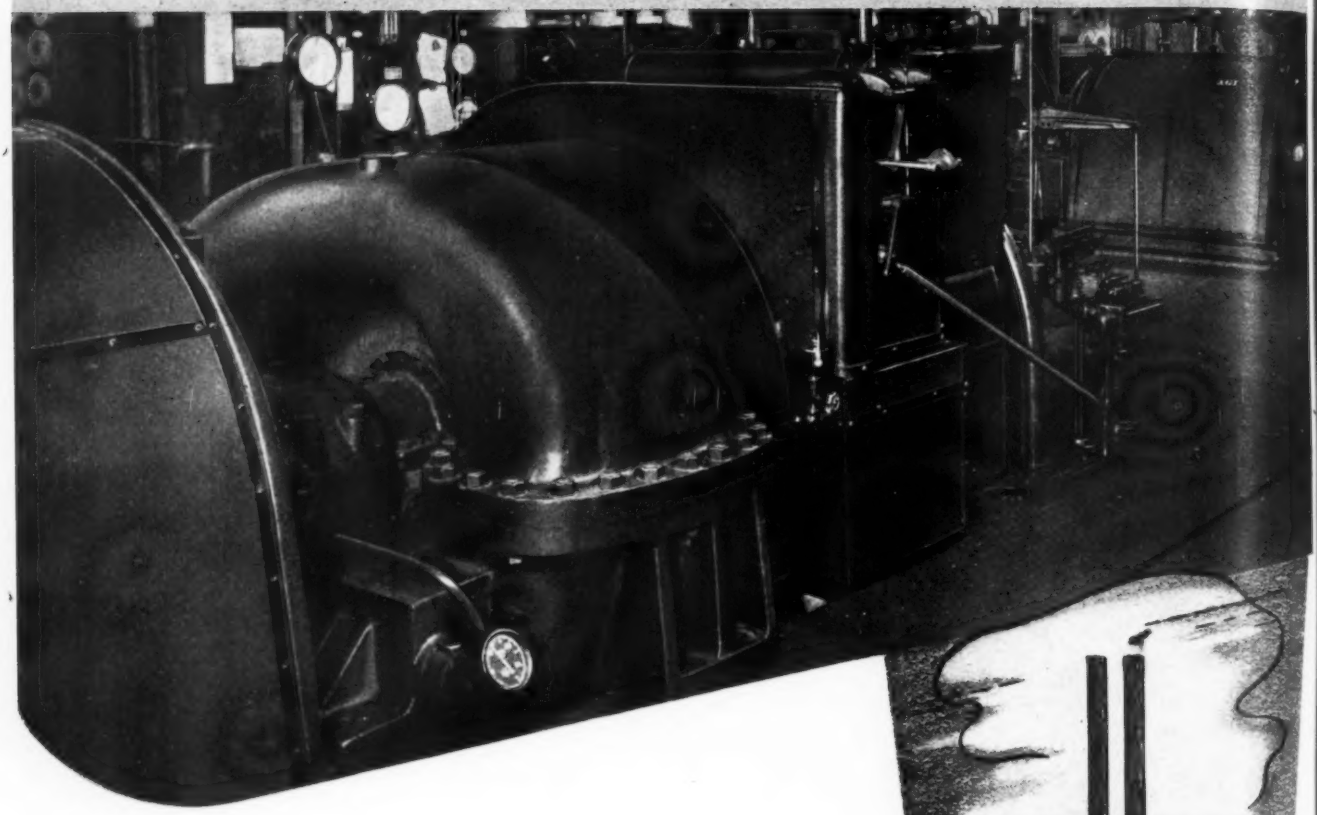
Homestead 3-Way or 4-Way Quarter-Turn Valves are made in sizes ½" to 12", in brass, acid-resisting bronze, semisteel, steel, Monel, Ni-Resist and other alloys for specific temperature, pressure and fluid conditions. For greater economy and convenience, specify Homestead 3-Way or 4-Way Quarter-Turn Valves on your next job. Consult Homestead engineers freely on all your valve problems. Write today for your copy of Valve Reference Book No. 38.

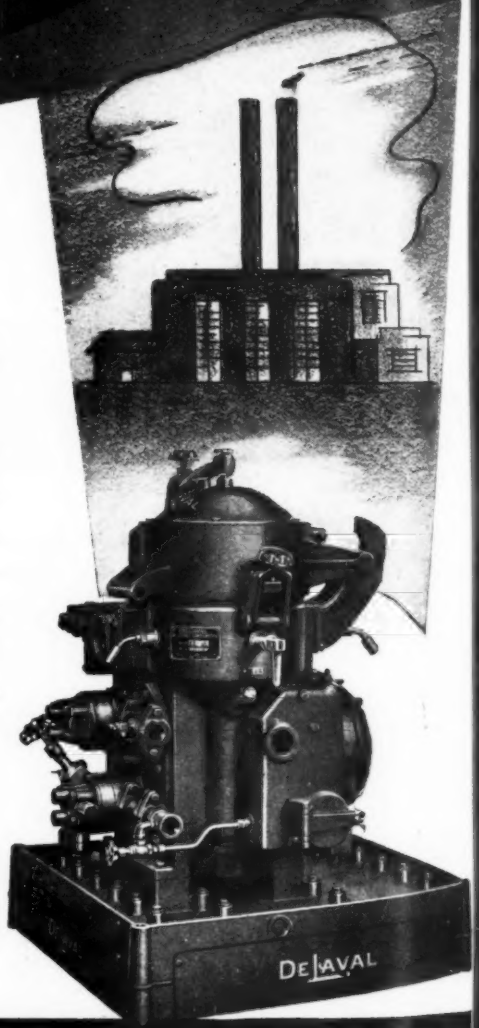
Maritime's two-flag, highest production award to our men and women making valves for the Victory Fleet.

HOMESTEAD VALVE MFG. CO.

P. O. BOX 210 . . . . . CORAOPOLIS, PENNSYLVANIA

THESE TURBINES *Must* SERVE FOR THE DURATION · · · *and* AFTER





BECAUSE so much depends upon the continued efficient operation of the thousands of virtually irreplaceable generating units in central stations and private power plants throughout America, the protection which De Laval Oil Purifiers afford them is more than ever necessary at this time. Fortunately most of the larger of these units and hundreds of smaller ones already have such protection.

De Laval Oil Purifiers keep turbines and engines free from the two great sources of lubricating trouble: Water which can lead to oil failure and which also accelerates sludge formation; and dirt which causes excessive wear on bearings and other moving parts and in extreme cases may shut off the oil supply. Thus most of the danger of trouble with bearings and other lubricated parts is avoided when a De Laval Purifier is used.

There is a De Laval Oil Purifier and system for every size and type of power plant. In writing, please state your particular problem so that De Laval engineers can be of utmost help—without obligation, of course.

THE DE LAVAL SEPARATOR COMPANY, New York, Chicago
DE LAVAL PACIFIC CO., San Francisco
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS

COTTRELL PROCESS

of

ELECTRICAL PRECIPITATION

universally recognized as a
standard method of removing

DUST, FLY ASH, FUME, MIST & FOG

***from* GASES**

•

30 years of research, development and operating experience throughout the world are incorporated in the

COTTRELL INSTALLATIONS

offered to meet the requirements
of any problem by

RESEARCH CORPORATION

405 LEXINGTON AVENUE
NEW YORK CITY

59 EAST VAN BUREN STREET
CHICAGO, ILL.

Looking ahead with Asbestos

"Don't bother to answer, soldier. We know you've plenty on your mind—Japs, artillery fire, the next advance; urgent things like that. There's little time now to think about the materials that make your field telephone such an efficient piece of fighting equipment.

"But when the war is over, and you pick up that electrical engineering career again, you'll remember the things that served you well in the South Seas campaign; for instance, the K&M Ebonized Asbestos in your telephone kit."

Peace or war, K&M Ebonized Asbestos is an ideal electrical insulation for switchboards, panels, bus bar supports, testing tables, light switches. Being asbestos fibre, binding cement and insulating compound molded under tremendous pressure, it can absorb high voltages without puncture. Ebonized also withstands severe shock, vibration and temperature change.

Under the pressure of war, K&M has learned how to make its products *better* and *faster*. Constant research is leading to the development of many new and improved products for the future.

It is our belief that Industry will plan a way to use every bit of present research and "war-plus" production to meet the enormous needs of the "V" years ahead.

* * *

Nature made asbestos;
Keasbey & Mattison, America's asbestos pioneer,
has made it serve mankind . . . since 1873

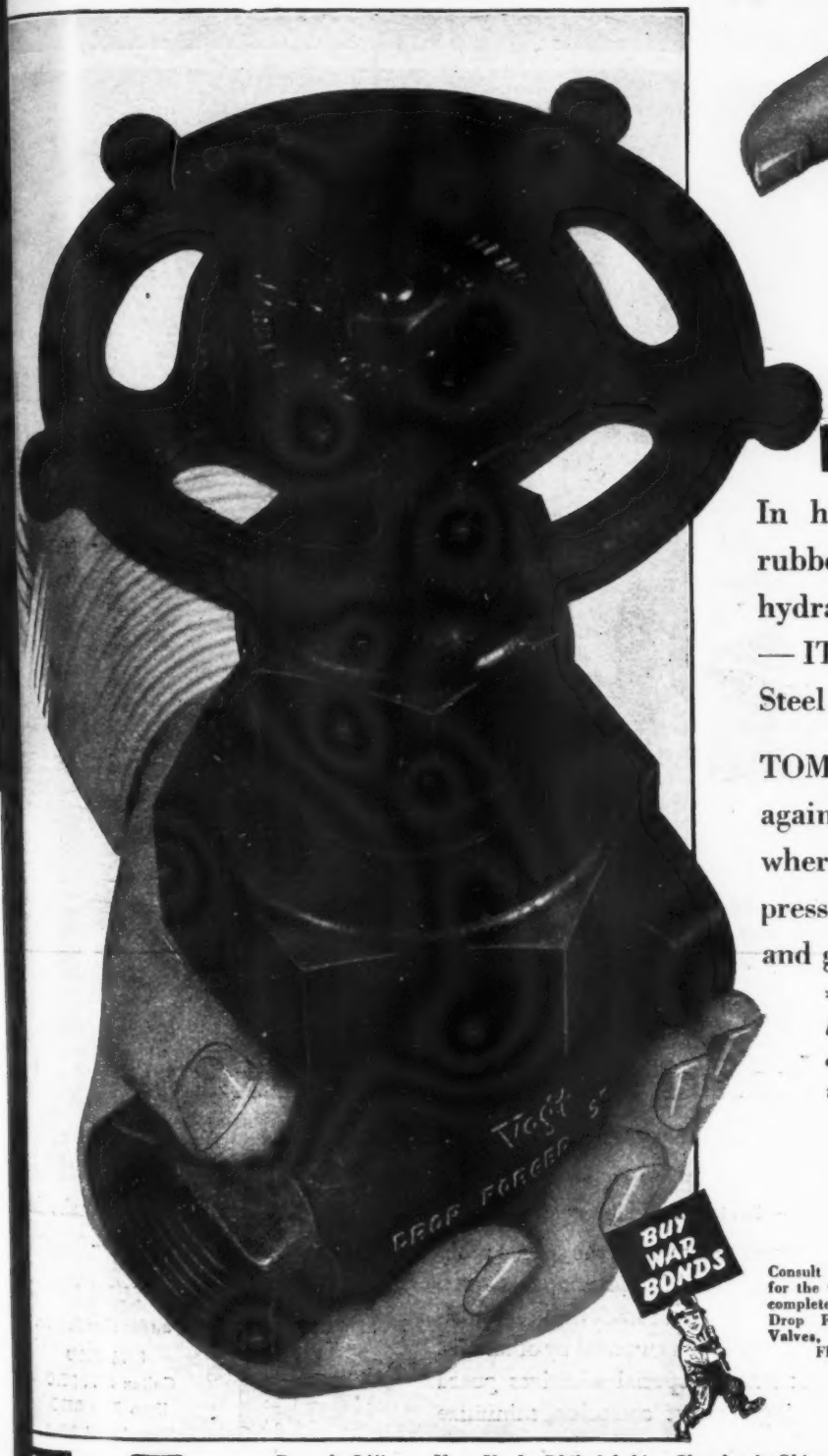
KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

Makers of

asbestos-cement shingles and wallboards; asbestos and magnesia insulations for pipes, boilers, furnaces; asbestos textiles; asbestos electrical materials; asbestos paper and millboard; asbestos marine insulations; asbestos acoustical material; asbestos packings; asbestos corrugated sheathing and flat lumbers; asbestos-cement pipe for water mains

K&M best in asbestos

TODAY LOOK FOR THIS



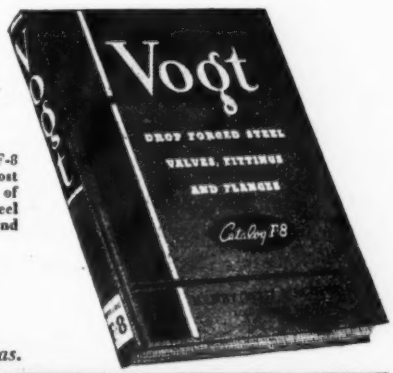
KNOBBED HANDWHEEL*

In high octane gasoline, synthetic rubber, powder, chemical, steam, and hydraulic plants, and marine service — IT identifies Vogt Drop Forged Steel Valves at work for Victory!

TOMORROW — Vogt Valves will again be available to ALL industries where sure and safe control of high pressure and high temperature liquids and gases is a MUST.

**Now available—a new line of malleable iron chain wheels, interchangeable with Vogt knobbed handwheels, for remote control of valves.*

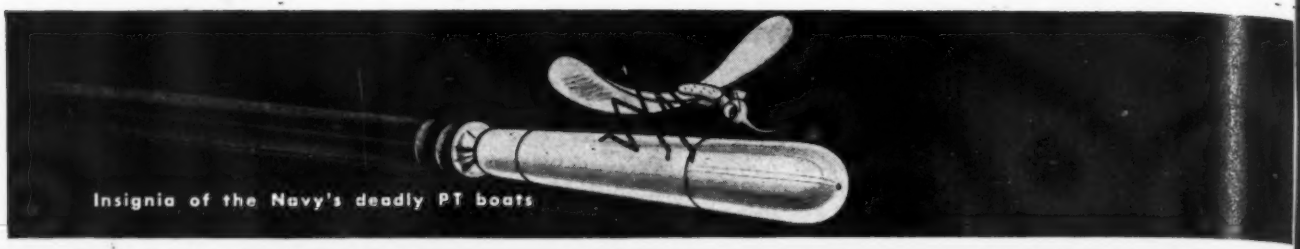
Consult Catalog F-8 for the world's most complete line of Drop Forged Steel Valves, Fittings and Flanges.



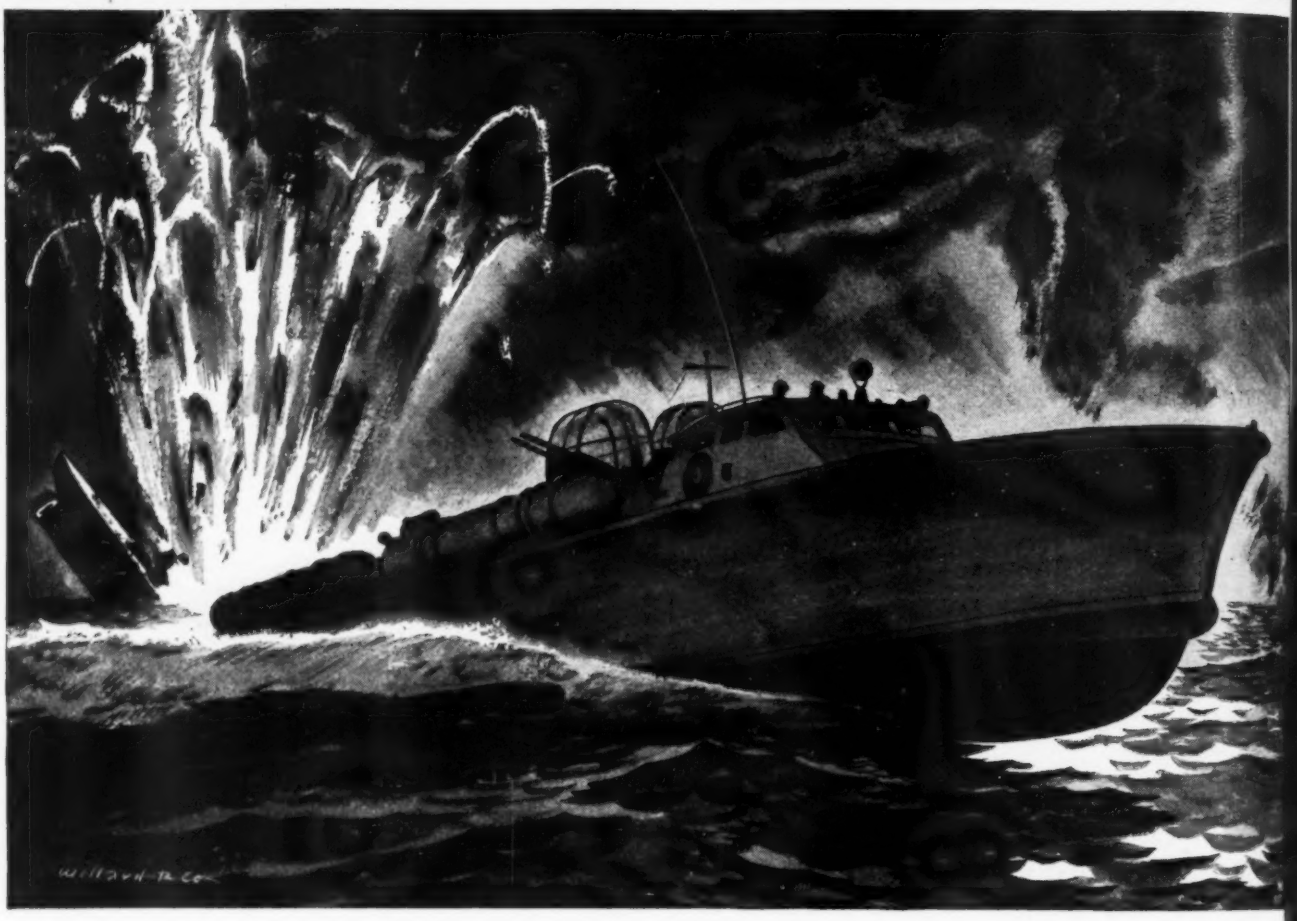
Branch Offices: New York, Philadelphia, Cleveland, Chicago, Dallas.

Vogt DROP FORGED STEEL Valves

HENRY VOGT MACHINE CO., LOUISVILLE 10, KENTUCKY



Insignia of the Navy's deadly PT boats



What makes a mosquito buzz?

Muffled motors roar suddenly as the PT boat starts her sprint. Almost before tracers arch from the enemy cruiser, the Yankee Mosquito knifes in, lays her long, lethal egg and bounces away at a wide open 70 knots. Scratch another Nip cruiser.

Such hit and run fighting demands motors that don't miss. They must hum flawlessly to take a 77-foot cockleshell under enemy guns. And PT motors *don't* miss—RPM DELO helps guarantee that.

Developed to solve the special problems of Diesel lubrication, RPM DELO ends the danger of stuck rings. It actually cleans motors gummed by other oils. RPM DELO's special additives guard bearings against corrosion, minimize sludge, cut wear to a fraction.

If you're interested in slicing repairs as much as 50%, in doubling the time between Diesel overhauls, remember the lubricant that helps make the Navy's Mosquito boats buzz.

ORDER RPM DELO FOR YOUR DIESEL

RPM DELO is marketed under these names:

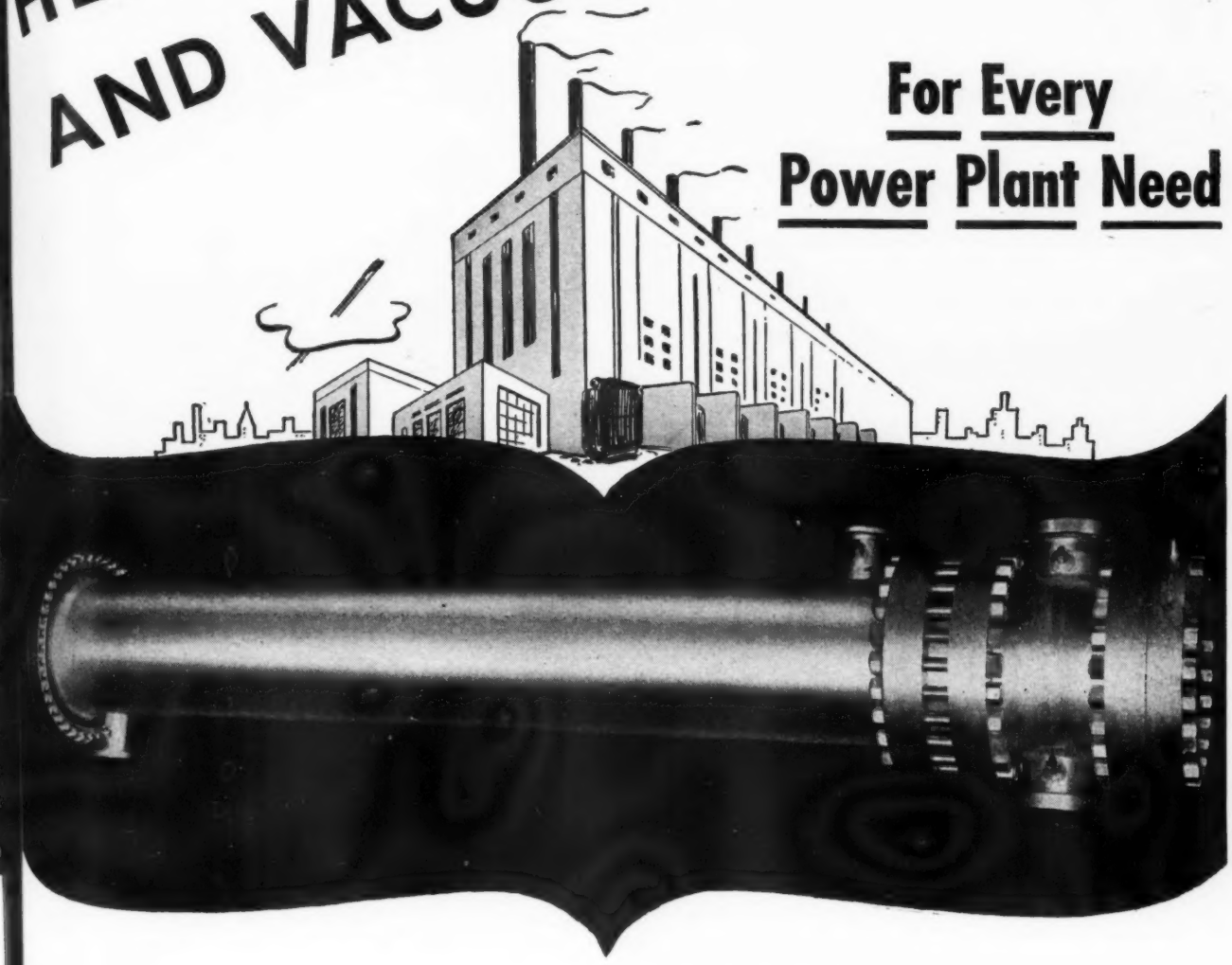
RPM DELO
Caltex RPM DELO
Kyso RPM DELO
Signal RPM DELO
Sohio RPM DELO
Imperial-RPM DELO
CONCENTRATE

Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your vicinity

STANDARD OIL COMPANY OF CALIFORNIA

HEAT INTERCHANGE AND VACUUM EQUIPMENT

For Every Power Plant Need



As a major producer of heat interchange equipment, Lummus designs and builds a complete line of

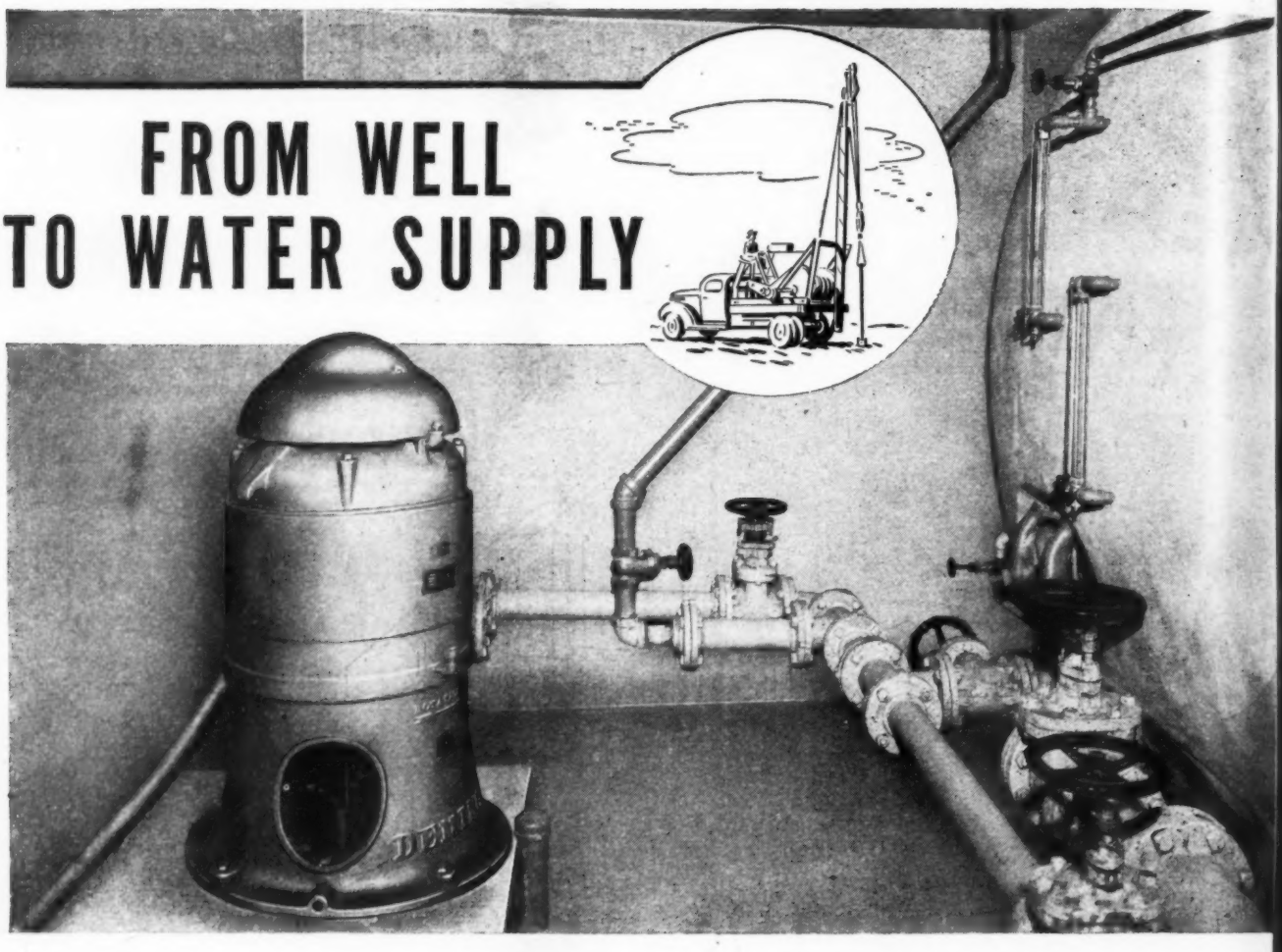
★ Surface Condensers
★ Steam Jet Air Pumps
★ Bleeder Heaters
★ Boiler Blowdown Heat Exchangers
★ Evaporators
★ Fuel Oil Heaters
★ Lubricating Oil Coolers

The services of Lummus engineering personnel are available to public utilities and industrial power plants for the study of specific problems and the design of heat exchange and vacuum equipment to meet individual conditions.

THE LUMMUS COMPANY • 420 LEXINGTON AVE., NEW YORK 17, N.Y.

LUMMUS

FROM WELL TO WATER SUPPLY



Installed Completely by a Deming Distributor

From the drilling of wells to the installation of Deming Pumps, The Stephen B. Church Company, Seymour, Connecticut, provides an excellent example of a Deming Distributor capable of handling all details involving the installation of complete water systems.

The photograph illustrates part of a recent installation consisting of two "CHURCH" gravel packed wells, each with an approximate capacity of 350 gallons per minute. Installed in each well is a Deming *Water Lubricated* Deep Well Turbine Pump, driven by a 25 h. p. motor and with a capacity of 300 gallons per minute, working against a total dynamic head of 227 ft.

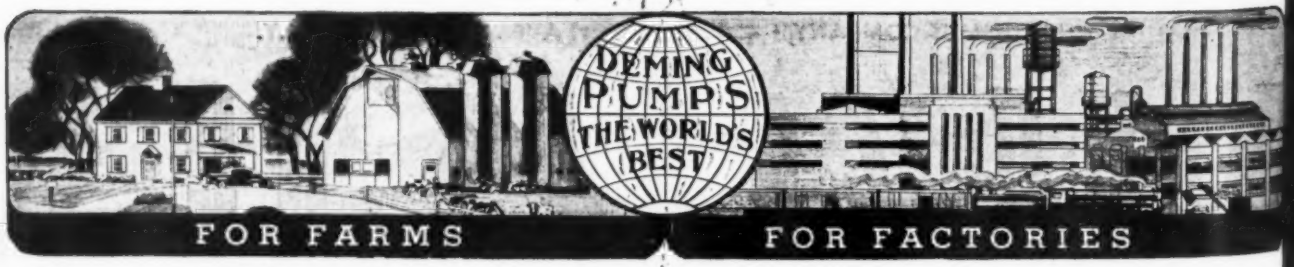
The Stephen B. Church Company, established 1886, has installed DEMING PUMPS since 1932. Many of these pumps are operating on a 'round-the-clock schedule in vital war plants.

The Deming Distributor in your area is a qualified source of cooperation in meeting your particular needs for water supply as well as many other types of pumping requirements.

See your Deming Distributor or write us for complete information on specific pumping problems.

THE DEMING COMPANY • SALEM, OHIO

DEMING PUMPS



Sturdy

ENOUGH TO MEET THE . . . "UNPREDICTABLE"

Constantly subject to all the known stresses and strains of present-day production, your power transmission also must be sturdy enough to meet and conquer the "unpredictable" . . . those unforeseen factors which are encountered daily in the busy plant.

Let us give you the proved benefit of our nearly 90 years' experience in supplying truly satisfactory Power Transmission Equipment.

T. B. Wood's

SONS COMPANY
CHAMBERSBURG, PA.

LONG LIFE LINE

EVERYTHING IN TRANSMISSION

BEARINGS – COLLARS – CLUTCHES – COUPLINGS – CONTACTORS – HANGERS – PILLOW BLOCKS – PULLEYS–V-BELT SHEAVES AND COMPLETE DRIVES

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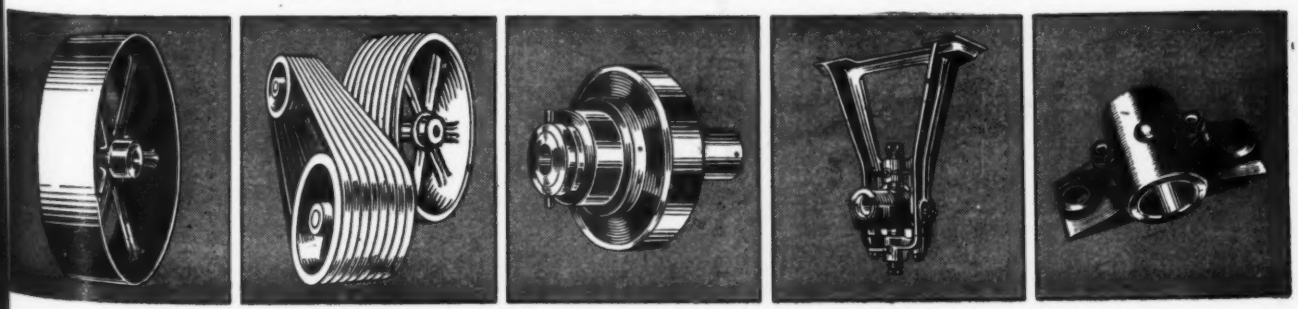


NO VALVE PROBLEMS *now!*

Two years ago I read these common sense suggestions in a Leavitt advertisement headed "13 Ways to Make Your Valves Last Longer."

The plan has worked so well for us that I'm passing it on to you as "14 Ways." The 14th? Use

DEXTER VALVE RESEATING EQUIPMENT

14 Ways to make your Valves *last longer*

This "Preventive Maintenance" will save valves, eliminate waste and shut-downs.

1. Inspect all valves regularly.
* 2. As soon as a valve leaks, reseat, regrind or rewasher it, before worn beyond repair or replacement.
* 3. If valves seat improperly, reseat them; don't force them.
4. Clean valves before installation and install carefully.
5. Cut pipe threads to proper length to prevent running up against seat diaphragm and ruining seat.
6. Put pipe compound on the pipe, not in valve, where it gums up working parts.
7. Use proper size wrench on valve to prevent distortion or straining.
8. Keep valves closed during installation to avoid entry of dirt.
9. Support long pipe lines properly to avoid springing valve seats.
10. Tighten all bolts or flanges on bonnets uniformly.
11. Blow or flush foreign substances from valves immediately after installation.
12. Use handwheel, not bars or wrenches to operate a valve.
13. Open valves or pressure lines slowly to eliminate undue strains on lines and fittings.
*14. USE DEXTER VALVE RESEATING EQUIPMENT TO PROLONG VALVE LIFE.

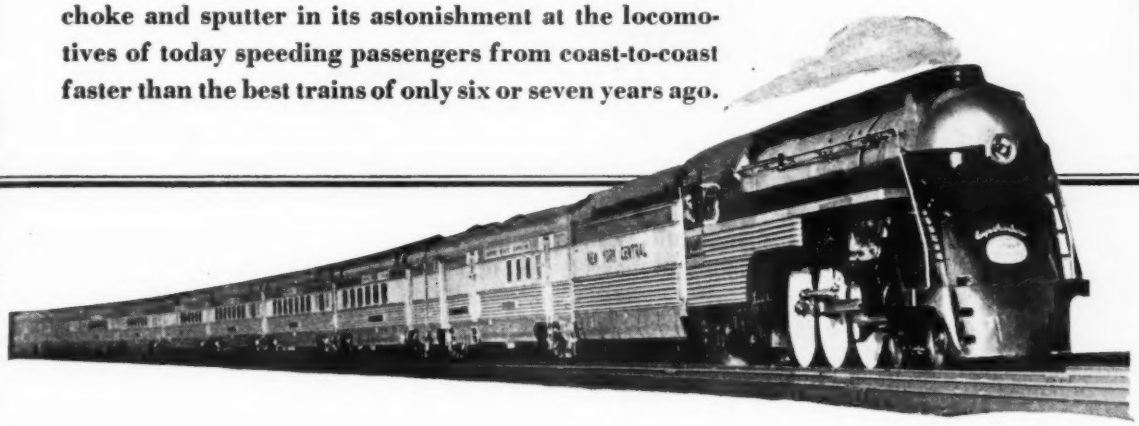
WRITE FOR DATA

A COMPLETE VALVE RESEATING OUTFIT IN A HANDY KIT-BOX —for Globe, Gate and Pump Valves

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

....From the Pride of the '60's to Locomotives of '43

The luxuriously appointed train of the '60's would choke and sputter in its astonishment at the locomotives of today speeding passengers from coast-to-coast faster than the best trains of only six or seven years ago.



There Has Been Progress In Water Conditioning, Too

Scientific diagnoses and preventive measures in the field of industrial water conditioning have far out-distanced the old method of preventing scale, corrosion, carryover and embrittlement with its one general formula.

The Bird-Archer Organization of Mechanical Engineers, Chemical Engineers and Chemists is trained and skilled in the science and practice of water conditioning. None is more competent to help you.

SURVEYS • PLANT STUDIES • CONSULTATIONS • TREATMENTS
PLANT DESIGN • SUPERVISORY SERVICE • LABORATORY SERVICE

THE BIRD-ARCHER CO.

Water Conditioning Service

NEW YORK, N. Y. • CHICAGO, ILL. • PHILADELPHIA, PA. • MONTREAL, CANADA

★

10-BA-1

SAVES 61 REPACKING JOBS $199.17 on ONE PUMP with DARCOVA PUMCUPS

"We were repacking a Simplex steam pump on one of our critical service gasoline lines every 4 days," reports a large and well-known refinery. "Based on the millions of barrels pumped annually, this was running into a costly operation figure and something had to be done about it."

"Then, we installed Darcova Pumcups and kept track of the costs. Today, those same Pumcups are still operating in the pumps and going strong, having already shown a 245-day savings of $199.17. What's more, from the time of installation the Darcova Pumcups materially reduced slippage and increased pumping capacity by 1800 gallons per hour."

You, too, can make important savings! Don't wait—start now to cut your reciprocating pump costs by installing Darcova Pumcups. Your pumps, new or old, regardless of present packing will operate with more efficiency, once this money-saving Darcova installation is made.

Take Advantage of the FREE DARCOVA SURVEY SERVICE

Darcova engineers can help you get the most from your pumping dollar. Phone, wire, or write—or ask any supply store. Darcova offers a complete line of Pumcups, Pistons, Valve Cups, Balls and Seats, Seating Cups, Seating Rings for oil well and reciprocating pumps.

A Simple Operation Removes Your Present Pistons and Equips Your Pump With This Inexpensive Adapter

Here is a close-up photograph showing the assembly of Darcova Pumcups and a Darcova Pumcup Piston. The piston is inexpensive and easy to install on any type of piston rod in your reciprocating pumps, regardless of make or model. The metal parts of Darcova Pumcup Pistons are machined to close tolerances to assure accurate fit of cylinder bore and Pumcups.

DARCOVA TRADE MARK
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

How you can get more heat with less fuel

In *normal* times fuel conservation is figured in dollars saved. But not so now. This is war . . . Today Uncle Sam allots to building owners in rationed areas a certain amount of fuel—and it's up to him to get along as best he can *within that ration.*

Seven out of ten large buildings in America (many less than ten years old) can get up to 33 per cent more heat out of the fuel consumed!

We didn't pick that figure out of the air. We've got the facts to back it. Webster Engineers surveyed thousands of buildings to give owners an accurate estimate of the extra-heat-per-unit-of-fuel to be achieved with a Webster Heating Modernization Program.

Take the first step now toward getting more heat out of your fuel ration next winter. Write today for "Performance Facts"—a free booklet containing case studies of 268 modern steam heating installations—"before-and-after" facts as told by the building owners themselves.

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in principal cities: Darling Bros., Ltd., Montreal, Canada

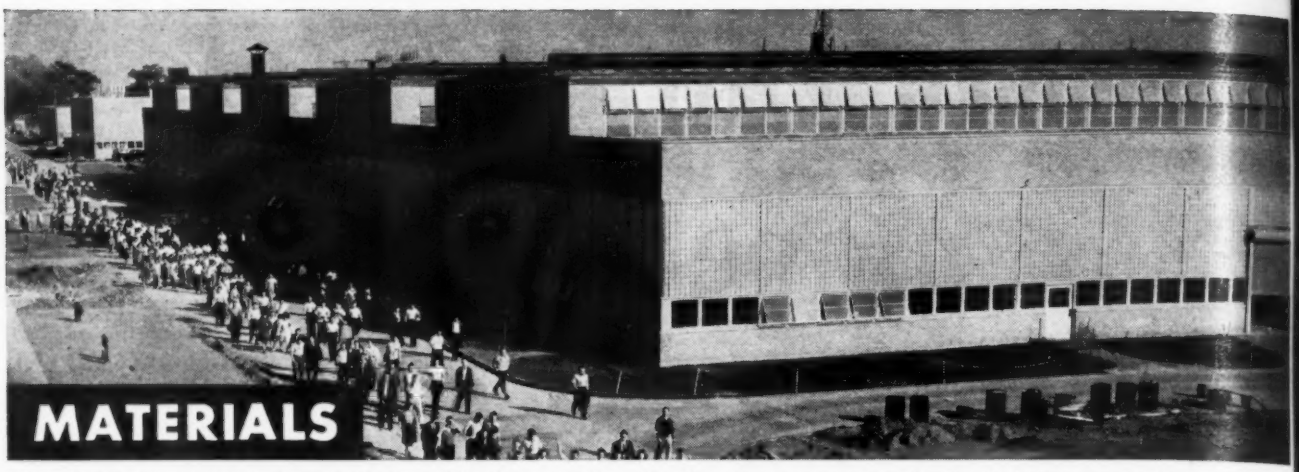
ARMY E NAVY

Webster
Steam Heating

TO WEBSTER OUTDOOR THERMOSTAT ➤

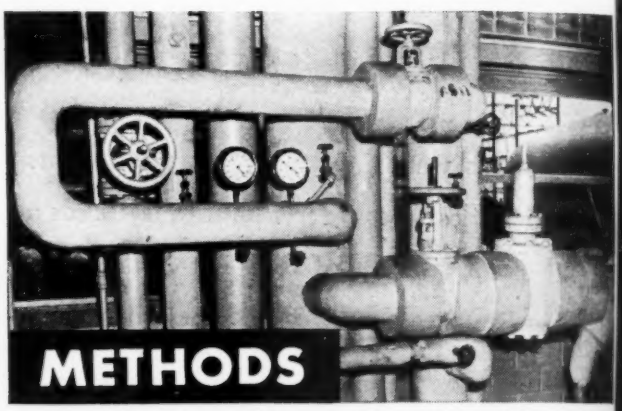
Shown at left is the small Control Cabinet of a Webster EH-10 Moderator System, central heat control of the pulsating flow type. It can be used to automatically operate a motorized valve in steam mains, or directly control burner or stoker of your boiler. This Moderator System is used chiefly for the small and medium size building. For the larger building, Webster Type E-4 Moderator System is generally recommended. Full details of these Webster Systems on request.

TO STEAM VALVE, BURNER OR STOKER ➤



INSULATION MATERIALS AND PRODUCTS used in the manufacturing, foundry, personnel and office buildings at the Nassau Plant of Sperry Gyroscope Company included: Magnesia Piping; Imperial and Air Cell Pipe Covering; Double Construction Anti-Sweat Coverings; Magnesia and Imperial Blocks for flat surfaces... all Ruberoid.

FULL-TIME STAFFS of skilled insulation experts make Ruberoid installations. Magnesia-Asbestos Insulation Co., New York, handled this project. Ruberoid Approved Applicators are available in all principal industrial areas.



RUBEROID provides a specific method for each insulating problem — combines it with the right material and the right men. This kind of service, founded upon years of experience and research, guarantees highly efficient installations.

What's so different about this insulation job at Sperry's new war plant?

Just this: Men, Methods and Materials for the Sperry installation were furnished *as one service.*

The only way to be fully certain of maximum insulating efficiency is to get all *three:* MATERIALS from one line broad enough to meet exact specifications... MEN to make the installation who are not only top-grade technicians but experienced with the materials being used... METHODS for doing the job evolved from years of experience and constant research.

The right Men, Methods and Materials—working together as one team—is the Ruberoid way of insulating.

• • •

Call in a Ruberoid engineer who will welcome the opportunity to tell you more about it.

RUBEROID INSULATION PRODUCTS

Imperial Asbestos Insulation
85% Magnesia Insulation
Air Cell Pipe Covering
Woolfelt Pipe Covering
Sponge Felt Pipe Covering
Mineral Wool Insulations
High Temperature Insulations
Low Temperature Insulations
Asbestos Papers & Boards
Insulating Cements

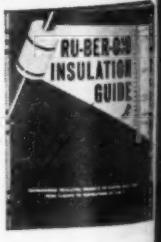
MATERIALS, MEN, METHODS—all 3 with

RU-BER-OID

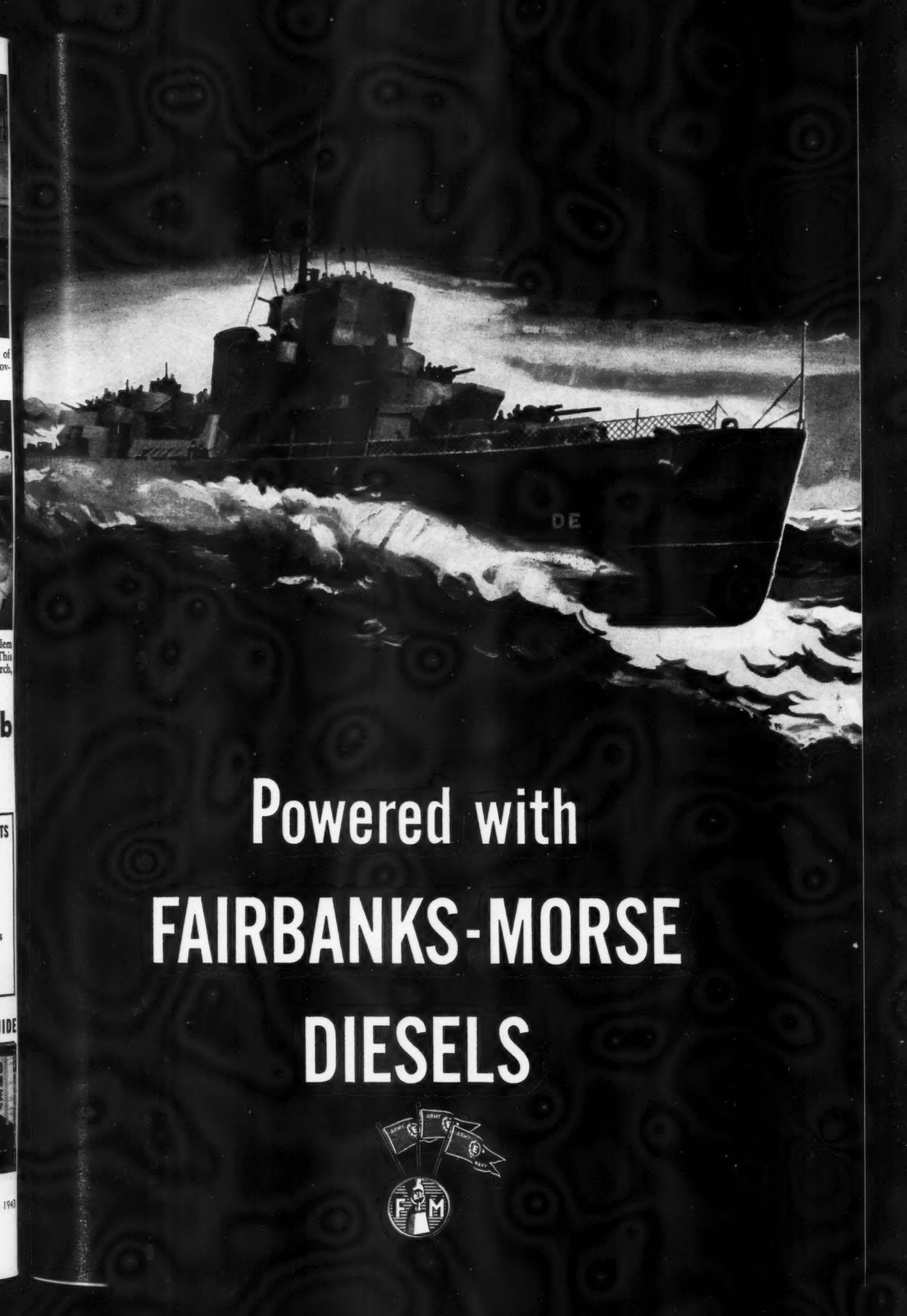
THERMAL INSULATIONS

WRITE FOR NEW INSULATION GUIDE

Side index gives, in seconds, the temperature you are interested in and the material for it. For free copy address Dept. HP-10, The RUBEROID Co., 500 Fifth Ave., New York 18, N. Y.



Service to Industry since 1886 . . . Genuine **RU-BER-OID** *Roofings and Building Products*


DE
Powered with
FAIRBANKS-MORSE
DIESELS
ARMY
ARMY
ARMY
NAVY
F M

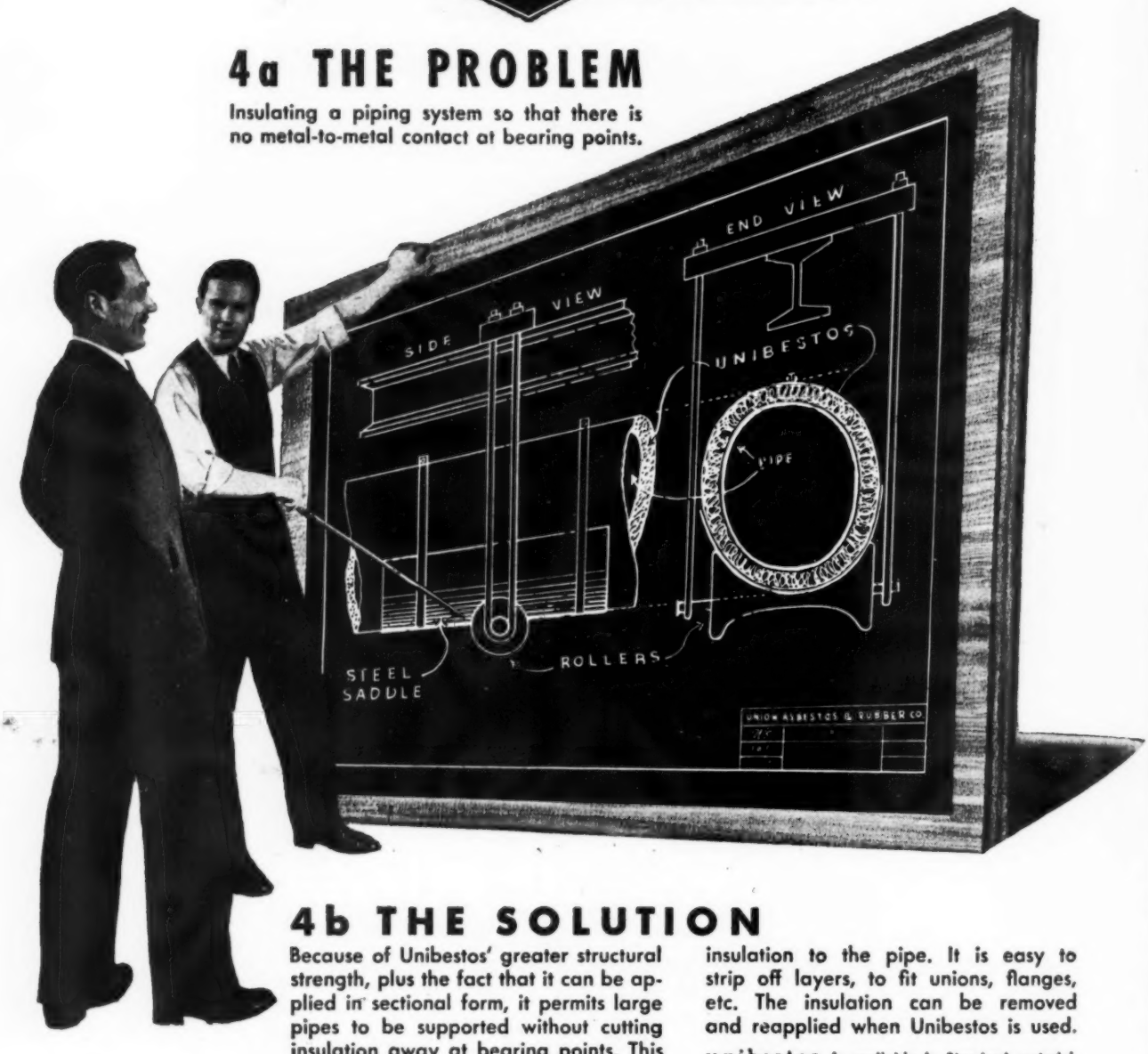
This is the 4TH in a series of messages

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING

UNARCO unibestos

4a THE PROBLEM

Insulating a piping system so that there is no metal-to-metal contact at bearing points.



4b THE SOLUTION

Because of Unibestos' greater structural strength, plus the fact that it can be applied in sectional form, it permits large pipes to be supported without cutting insulation away at bearing points. This is done by laying a steel saddle under the insulation at points where the pipe is supported by rollers, tie rods or other means. This makes it unnecessary to cut away the insulation or to use metal supports that penetrate through the insulation to the pipe. It is easy to strip off layers, to fit unions, flanges, etc. The insulation can be removed and reapplied when Unibestos is used.

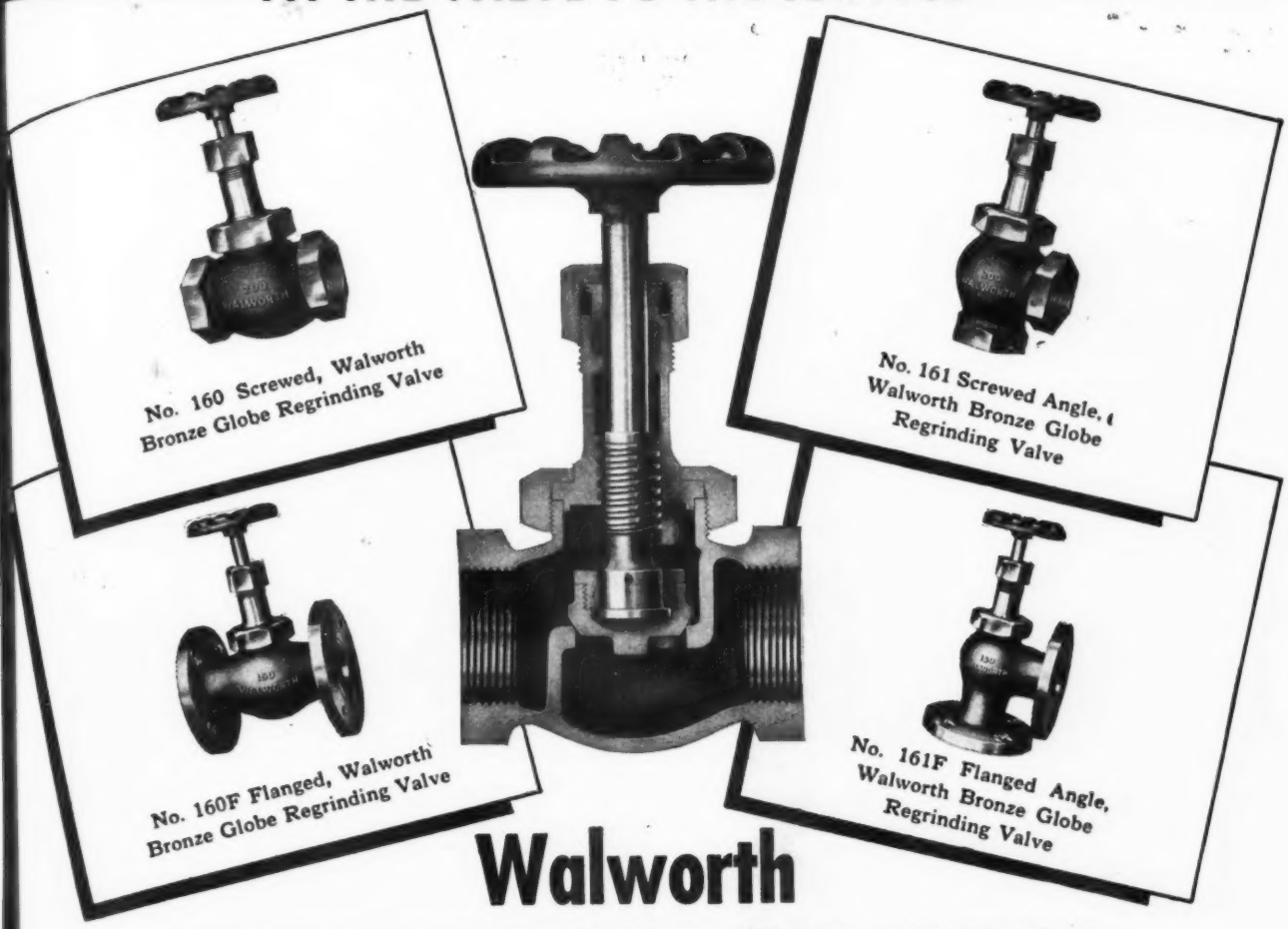
unibestos is available in Standard material, for temperatures up to 750°; Super, with a temperature limit of 1200°; Combination, with a temperature limit of 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes. Unibestos is available in half sections up to 30" pipe diameter and from 32" to 60" in quadrants from ¾" to 5" in thickness. Standard and Super are available in single layer construction with provision for expansion in piping, where required.

TWO ARMY-NAVY "E" AWARDS FOR EXCELLENCE IN WAR PRODUCTION ONE TO THE CICERO, ILLINOIS PLANT, ONE TO THE PATERSON, N. J. PLANT

UNION ASBESTOS & RUBBER CO.

GENERAL OFFICES: 1821 SOUTH 54TH AVENUE, CICERO, ILLINOIS • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

FIT THE VALVE TO THE SERVICE


No. 160 Screwed, Walworth Bronze Globe Regrinding Valve
No. 161 Screwed Angle, Walworth Bronze Globe Regrinding Valve
No. 160F Flanged, Walworth Bronze Globe Regrinding Valve
No. 161F Flanged Angle, Walworth Bronze Globe Regrinding Valve

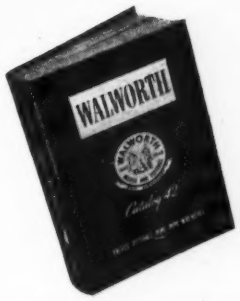
Walworth
BRONZE REGRINDING VALVES

• • •

choose the type that fits your service

When you need a Bronze Valve select from Walworth's *complete line* the one that precisely fits your service. Take this line of regrinding valves, for example. These valves are made both in Globe and Angle types with either screwed or flanged ends. Union Bonnets give added strength. All valves have bronze discs and full-way seats. Moreover, well proportioned stuffing boxes and glands assure leak-proof operation. These valves can be repacked under pressure when fully opened, and should the seats and discs become worn, they can be reground.

Each Walworth Valve has distinctive features of design and construction. You can save time, material, and much troublesome maintenance when you "fit the **valve** to the service."



To help you "fit the valve to the service," you'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the New Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 E. 42nd St., New York 17, N. Y., Department 06.

BOSTON WORKS
KEWANEE WORKS

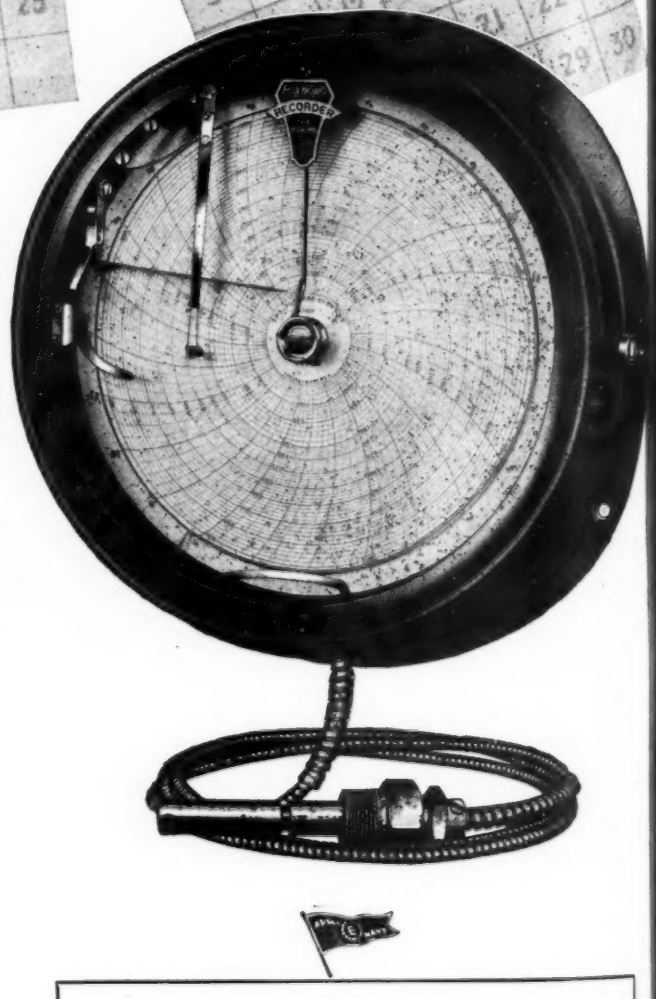
WALWORTH
valves AND fittings

WALWORTH VALVES AND FITTINGS ESTABLISHED 1842

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

How Long

since you "TOOK CENSUS" of your TEMPERATURE RECORDERS?



Now's the time to check up whether you've been overlooking important installations

Have you had a chance since pre-war days to survey your whole plant set-up with a view to getting *all the help you can* from Temperature Recorders? If not, you may be surprised to find how much your overall production can be improved by equipping a few neglected points with Foxboro Temperature Recorders.

These precision-engineered instruments give unerring guidance that eliminates any need for guesswork in controlling critical temperatures. Their ultra-sensitive thermal system reacts to slightest changes . . . their light, strong recording mechanism "writes it down," instantly and continuously, without loss of accuracy.

No matter what step in your operation demands uniform temperature, Foxboro Temperature Recorders will automatically give you the exact information to save quality-variations, spoilage, re-runs and lags in output.

Why not make a list *right now* of the trouble-spots that Foxboro Temperature Recorders might eliminate once and for all? Write for detailed Bulletin 198-2. The Foxboro Company, 68 Neponset Avenue, Foxboro, Massachusetts, U. S. A.

TEMPERATURE RECORDERS

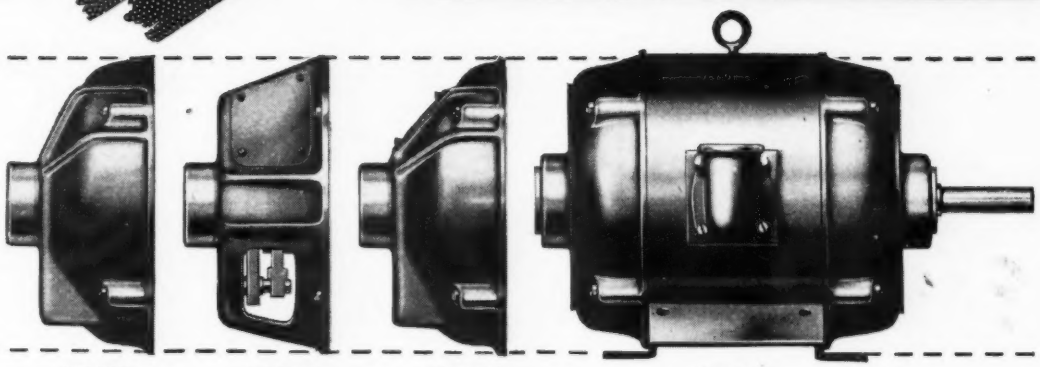
by

FOXBORO

REG. U. S. PAT. OFF.

Be Ready for the POSTWAR MARKET with Revolutionary R&M Uni-Shell INTERCHANGEABLE MOTORS

ONLY THE END HEADS CHANGE



CAPACITOR SINGLE-PHASE INDUCTION MOTOR 1-5 H. P.

D. C. MOTOR AND GENERATOR 1-7½ H. P. ¾-5 K. W.

REPULSION INDUCTION MOTOR 1-5 H. P.

POLYPHASE INDUCTION MOTOR 1-30 H. P.

READ ABOUT THESE Uni-Shell ADVANTAGES

1. Complete interchangeability in any one frame size.
2. Trouble-free bearings and improved insulation for longer life.
3. Many interchangeable flanged end-heads for vertical or horizontal mounting.
4. Adaptability to drip-proof, splash-proof and totally enclosed fan cooled construction.
5. Polyphase induction, Direct Current and Single-Phase Induction types.

COMPLETE INTERCHANGEABILITY WILL HELP SPEED PRODUCTION CHANGE-OVER

Whether you are a producer or user of machine tools, you can profit from the interchangeability and exceptional efficiency of R & M Uni-Shell Motors. No other motors can offer these advantages for postwar conversion and operation. In all Uni-Shell types, the shell length, diameter, base mounting holes, shaft dimensions, height of shaft above base, head fit and bolt circle mounting for heads are exactly the same for any frame size. Only the end opposite the shaft extension varies from one type to another.

This feature of interchangeability represents a great advance in motor building—but there are other features of comparable value. Improved insulation techniques, trouble-free bearings and alignment, precision-balanced rotors, and lower interior temperatures are remarkable achievements, too.

Get the full facts on Uni-Shell integral horsepower motors. Mail the coupon for the interesting, informative 20-page Uni-Shell booklet.

Mail This Coupon Today!

ROBBINS & MYERS, INC., Springfield, Ohio

Gentlemen: Please send me your new 20-page booklet on Uni-Shell Motors.

Name.....*Position*.....

Company.....

Street Address.....

City.....*State*.....

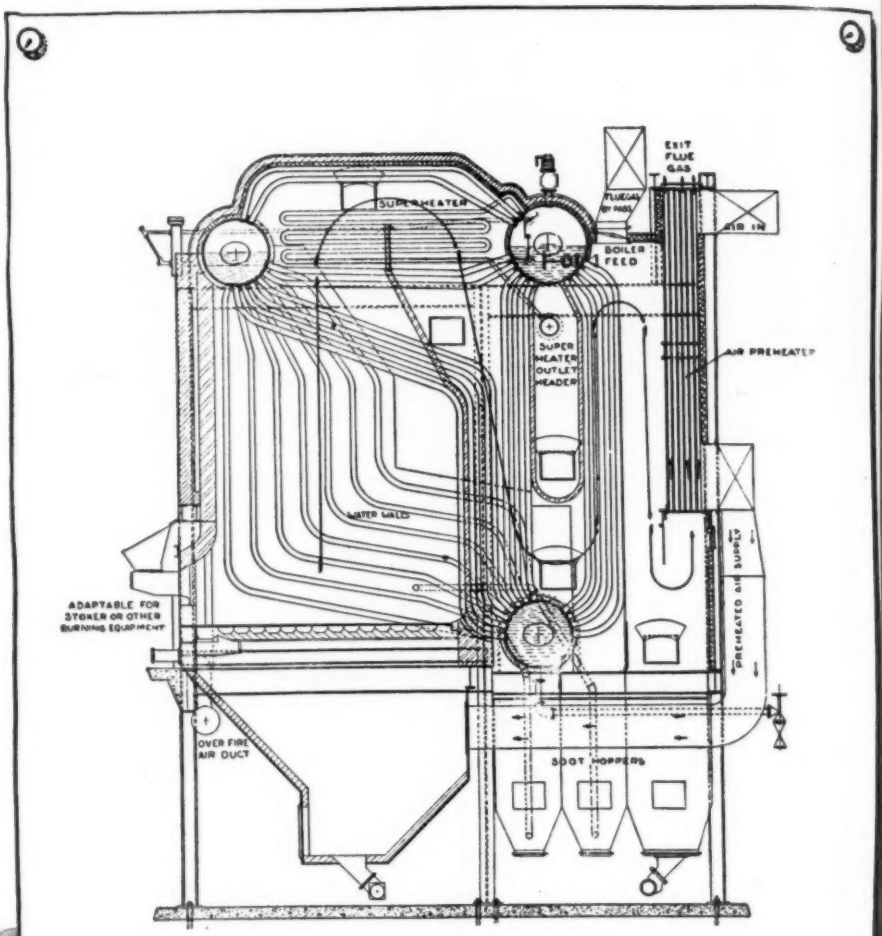
I would ☐ would not ☐ like to talk to a representative. 17

ROBBINS & MYERS • INC.

MOTOR DIVISION, SPRINGFIELD, OHIO

HOISTS & CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

By replacing old equipment with two of these EDGE MOOR Radiant Heat Boilers, one power plant operator found that fuel savings will pay all costs of the new installation in two years' time.



THIS
Edge Moor
RADIANT HEAT
BOILER...
...has INTEGRAL WATER WALLS!

In this EDGE MOOR three drum Radiant Heat Boiler a bank of specially formed tubes at each end of the front drum is connected to the lower drum so as to form water walls on both sides of the furnace. This construction is economical and actually provides water wall operating economy at little increase in boiler cost. The design pioneered by EDGE MOOR eliminates expensive water wall headers, circulating tubes, down comers and attendant parts which not only add to the investment but complicate the maintenance. Quick steaming, high ratings, side wall protection, moderate height, adaptability to any fuel are definite worthwhile features.

The list of EDGE MOOR installations is rapidly expanding and investigation is invited. Write for catalog 102.

EDGE MOOR IRON WORKS, INC.

EDGE MOOR, DELAWARE

STEAM GENERATING EQUIPMENT

SALES OFFICES: NEW YORK, N. Y.: 30 ROCKEFELLER PLAZ
CHICAGO, ILL.: ONE NORTH LA SALLE STRE

AVAILABLE

FOR PROMPT DELIVERY!

Taylor Etched-Stem Thermometers and Taylor Hydrometers

WE HOPE it's no news to you that Taylor makes accurate Etched-Stem Thermometers and Hydrometers. But we believe it *is* news when any product is available for *prompt shipment on low priorities*—and that goes for both these well-known lines, with the possible exception of certain types of metal armored etched-stem thermometers.

There's a complete choice of sizes and types of Taylor Etched-Stem Thermometers. All are made with the same "Shielded Mercury Bore" that makes Taylor Industrial Thermometers so easy to read.

Taylor Hydrometers are also available for all purposes. Streamlined "Easykleen" Hydrometers, with "Permax" scale permanently fused into the alloy weighting material, will stand temperatures up to 300°F. without discoloring or loosening.

If you need either Etched-Stem Thermometers or Hydrometers for laboratory or test use, mail coupon or write today for catalogs and prices! Or call your local Taylor office.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada. Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow, and liquid level.

SEND TODAY FOR CATALOGS AND PRICES!

Taylor Instrument Companies,
17 Ames Street, Rochester, N. Y.

Please send catalogs and prices on:

- ☐ *Taylor Etched-Stem Thermometers*
- ☐ *Taylor Hydrometers*

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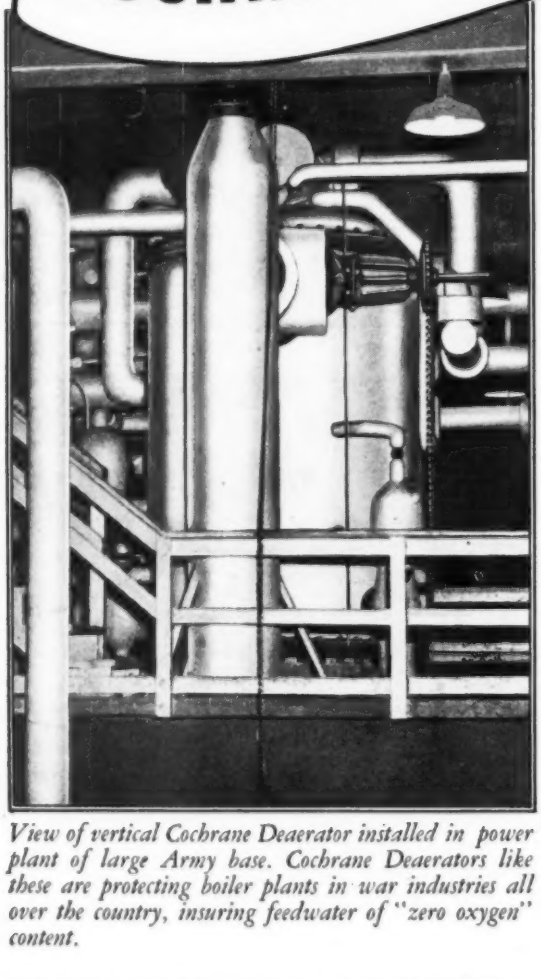
Address.....

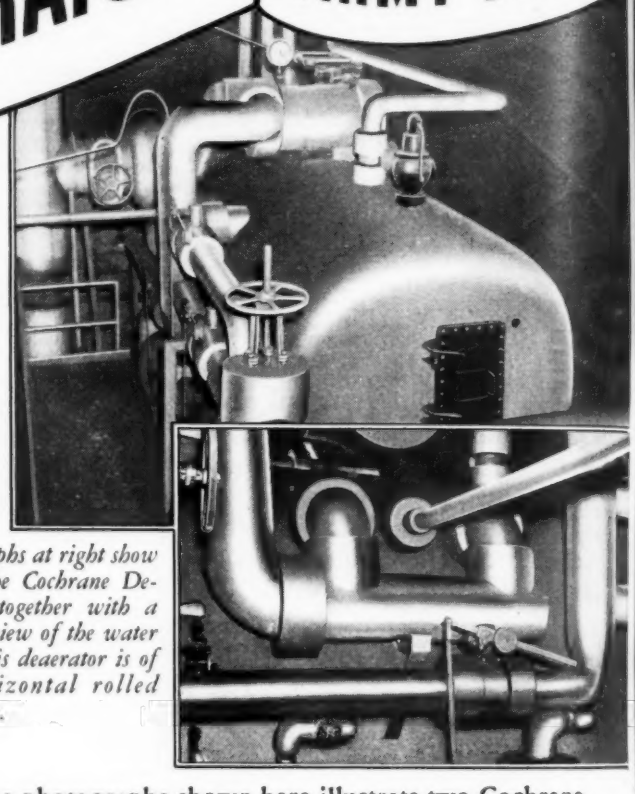
City.....*State*.....

COCHRANE DEAERATORS ARE IN THE ARMY TOO!

BACK THE ATTACK ★ BUY WAR BONDS



View of vertical Cochrane Deaerator installed in power plant of large Army base. Cochrane Deaerators like these are protecting boiler plants in war industries all over the country, insuring feedwater of "zero oxygen" content.



Photographs at right show one of the Cochrane Deaerators together with a close-up view of the water inlet. This deaerator is of the horizontal rolled plate type.

The photographs shown here illustrate two Cochrane Deaerators installed in one of the army's important power plants in the south. While the function of the deaerator is a relatively minor one in the production of the implements of war, it is gratifying to realize that because of the protection afforded to boilers, economizers and steel tubing in keeping them free from corrosion, the power plants of this great army headquarters will continue to function without "outage" for repairs to corroded steel equipment. Cochrane Deaerators supply oxygen-free feedwater on a guaranteed basis.

COCHRANE CORPORATION • 3106 N. 17th ST. • PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

This FIRE PROTECTION

by CARDOX Fire Extinguishing Systems

More war goods from fewer man-hours is one of America's most urgent needs today! Every hour saved here is another step toward victory.

One major fire—or a small fire that results in crippling damage by the extinguishing medium—can cut the flow of vital war goods to a trickle over night. Such fires may halt or slow down production on a dozen different types of essential fighting tools . . . waste precious man-hours and critical materials.

Cardox Fire Extinguishing Systems provide distinctive advantages in protecting production against these war-prolonging fires. They smother the fire and "cool out" combustibles through timed mass discharges of *pounds* or *tons* of CO_2 . . . with no damage by the extinguishing medium. Consequently, when fire strikes, men and machines are usually back in production quickly. Losses of vital materials are reduced to a minimum.

Industries guarding War-Winning Production with engineered Cardox Fire Extinguishing Systems include leading manufacturers of *Airplanes, Airplane Parts, Armor Plate, Aviation Carburetors, Aviation Engines, Cold Strip Steel, Electric Power, Engine Parts, Forgings, Motor Fuel, Plastics, Processed Fabric, Rubber Products, Solvents, Tanks, Tank Engines.*

Today, the facilities of Cardox are concentrated on two activities: (1) Providing fire protection for War-Winning Production; (2) Applying the technological knowledge gained here to help industrial, municipal, state and national fire fighting organizations perfect plans to increase the efficiency of fire protection both today and after the war.

If more information would help—in solving your fire protection problems of today or tomorrow—write on your company letterhead for Bulletin 9103.

★ ★ ★

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in New York • Washington
Detroit • Cleveland • Atlanta • Pittsburgh
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How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

CARDOX—CO_2 Systems with Enhanced Fire Extinguishing Performance

A. Uniformity of CO_2 characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of CO_2 through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox CO_2.

MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

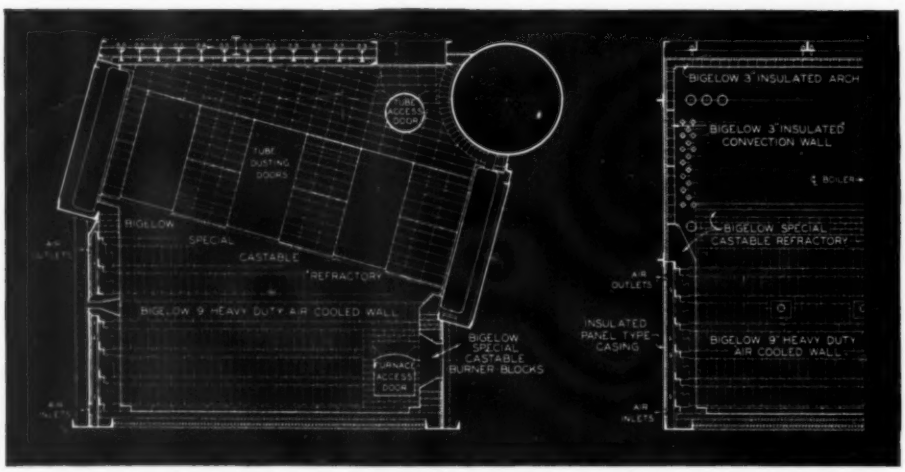
Case #1026 - Unit-Suspended, Air-Cooled, Boiler Enclosures that Withstand a Ship's Vibration and Shock

How Bigelow-Liptak engineering skill quickly made a sabotaged Italian ship ready for service of the United Nations, with new air-cooled, boiler enclosures that provide strength and assure minimum maintenance.

WHILE the Italian Steamship [redacted] was being interned by the United States at the Port of [redacted], back in August, 1941, all of its boilers were sabotaged by her Nazi crew. The rapidly growing developments of the war made it imperative that they be replaced and the ship quickly made ready for American service. An urgent telephone call brought Bigelow-Liptak engineers to the office of the marine boiler manufacturer, who had just accepted the responsibility for the new boilers. Facts were quickly assembled and a thorough analysis was under way. Boilers would be operated at higher-than-usual furnace temperatures. There was the problem of restricted space for these high boiler-furnace temperatures. Heavy vibration and shock from sea impact would be an obstacle not encountered in ordinary enclosure problems. And to these difficulties was added the need for quick work. The entire job would have to be done in record time.

The Solution

Today this expropriated Italian liner is in active service. Renamed the S. S. [redacted] and carrying men and supplies for our United Nations, its performance is an example of Bigelow-Liptak skill, versatility and ability to design practical and economical heat enclosures. Just a few weeks ago when this ship put into port for boiler inspection only the most nominal repairs to burner blocks, floors, baffles, etc., were required. Because of the ability of these Bigelow-Liptak designed enclosures to withstand hard service, the S. S. [redacted] was quickly back in the service of the United Nations.



Bigelow-Liptak Unit-Suspended walls are logically suited to applications of this type, where impact and shock may occur, because they are the strongest and safest of all wall constructions. Note that—contrary to usual marine practice—this encasement is air-cooled in the furnace areas. Since these boilers are operated at excessive furnace temperatures, furnace walls are air-cooled by natural convection to assure refractories the maximum life expectancy. The reduced maintenance problem, made possible by the air-cooling of the refractories, more than off-sets the resulting, comparatively low, conduction and radiation losses.

Casing plates were insulated to protect the firing crew from discomfort and the wall circulating air was discharged toward the upper part of the fire-room as shown above. Boiler tube areas above the furnace were encased with thin Bigelow-Liptak insulated walls and arches for minimum weight as well as maximum thermal efficiency and stability.

Your Enclosure Problem Can Be Satisfactorily and Economically Solved by Bigelow-Liptak

The designing of a satisfactory enclosure for a ship's boiler may have little resemblance to your own enclosure problem, but here lies the significant advantage in taking it to Bigelow-Liptak. With Bigelow-Liptak each case is an individual problem, regardless of its type or size. Each is thoroughly studied in relation to its own particular factors. Bigelow-Liptak's wide engineering experience in designing enclosures includes every type of problem having to do with thermo-dynamics, ceramics and mechanics of materials. This individualized engineering, based on years of experience and sound engineering principles, is applied towards giving the customer the best and most economical solution to his particular needs. Our policy is to give first and foremost consideration to the needs of the user.

The Key to Operating Economy

Bigelow-Liptak engineering and construction offer the key to operating economy with minimum maintenance, minimum conduction losses and maximum air-tightness.

Our engineering staff will be glad to send you interesting catalogs or tell you how you could secure increased service and economy by the use of Bigelow-Liptak Unit-Suspended walls and arches in your plant. Write today.

Unit-Suspended Walls + Arches

The Key to Operating Economy

BIGELOW-LIPTAK CORPORATION
DIVISION A. P. GREEN FIRE BRICK CO.
330 Curtis Building
DETROIT

BIGELOW LIPTAK Corporation

THE *New* ELLIOTT "F H" COUPLING *for tube cleaners*

This flexible coupling between motor and operating hose permits greater angular movement of the cleaner in curved tubes.

No more stiff, worn or oil soaked short sections of hose. No more restricted flow of air due to swelling and deterioration of hose. This new all metallic coupling permits whole unit to be stored in oil. It is sturdy, practically wear proof, and streamlined.

An Elliott Achievement. Details? Write to Tube Cleaner Headquarters for Bulletin on FH Couplings and new types of cleaners.

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Tube Cleaner Department
SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES
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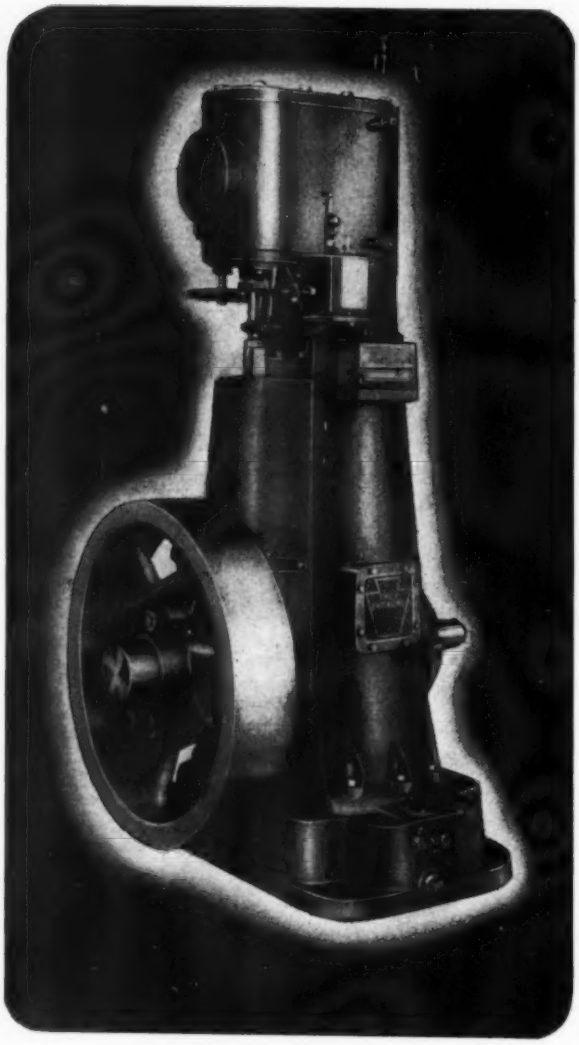

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THE Troy-Engberg Steam Engine rates high in dependability, economy and utility. Where plant conditions are favorable, it is the most modern drive for stokers, pumps, compressors, blowers, fans, generators and other boiler room and process plant equipment.

TROY ENGINE & MAC

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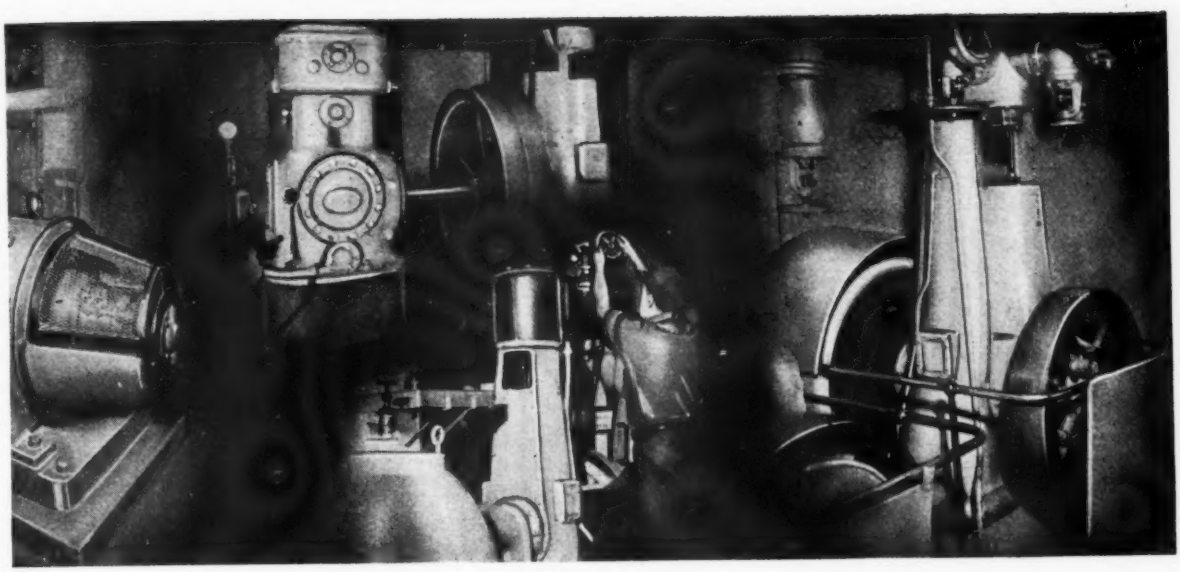
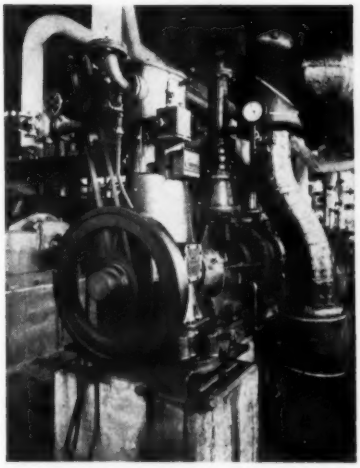
BUY
UNITED STATES DEFENSE BONDS AND STAMPS



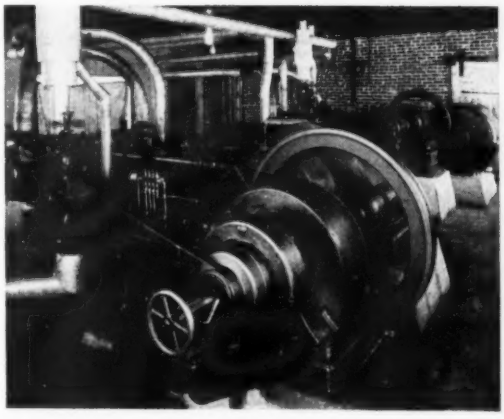
Engberg Power is low-cost Power

it's *By-Product* Power



WHEN heat balances are favorable, the Troy-Engberg Steam Engine captures the "by-product power" in the steam. We can point to many units where the savings made possible by this "by-product power" have been large enough to pay for the entire cost of the engine in only a year or two.

And there are other values along with economy. The Troy-Engberg Steam Engine offers a very wide speed range amenable to automatic control . . . high starting torque and ability to handle overloads over long periods . . . freedom from fire hazard . . . and, under certain conditions, oil-free exhaust. It provides steady operation over a period of many years without requiring major repairs.



NE COMPANY **1488 RAILROAD AVE.**
TROY PA.

10-TEM-5

What they can't see they can't hit . . .

In just a few more minutes you wouldn't have seen the source of this smoke barrage.

IN the last war smoke screens were laid by clumsy smudge pots. Today a far more effective screen is set up by the smoke generators pictured here in action on an army proving ground.

Thousands of these units, designed by the chemical warfare service of the army, have been produced by the Heil (right-in-the-Fuehrer's-eyes) Company of Milwaukee. Until a very short time ago, these smoke generators were strictly on the "hush" list . . . referred to as "tent heaters" in the Heil shops and office. But now the veil of secrecy has been lifted on one more master stroke of the brand of U. S. ingenuity that always wins.

Mounted on wheels, these smoke generators can keep up with the troops—are even used on landing barges and larger craft clear up to battleships. "Smoke", says the chemical warfare service, "is a primary requisite for camouflage and screening . . . the generators were used extensively in landing operations in North Africa . . . reduced the effectiveness of enemy fire 85%." Similar use of them has been made in the Sicilian campaign . . . confusing enemy fire . . . saving thousands of lives . . . screening vital military installations and supplies.

In these units, as in so many devices essential to modern warfare, Marsh Gauges are playing a vital role. They are one of those products that combines modern design with old-time thoroughness—one of those products that doesn't mind the rough spots on the road to Victory!

The Gauge with th "RECALIBRATOR"

A gauge built to Mars Standards is not likely be knocked out of adjus ment. But if it is, th Marsh "Recalibrator" w quickly restore its acc racy. Simply turn the "R calibrator" screw until th pointer is at zero when n under pressure. The gau will then be right at a points on the dial. Unli other methods of resetti the "Recalibrator" gets the root of the error—t establishes the relation the bourdon tube to th movement—actually r calibrates the gauge.

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MARSH GAUGES *The standard of accuracy*

RECISION PRE-FABRICATION!

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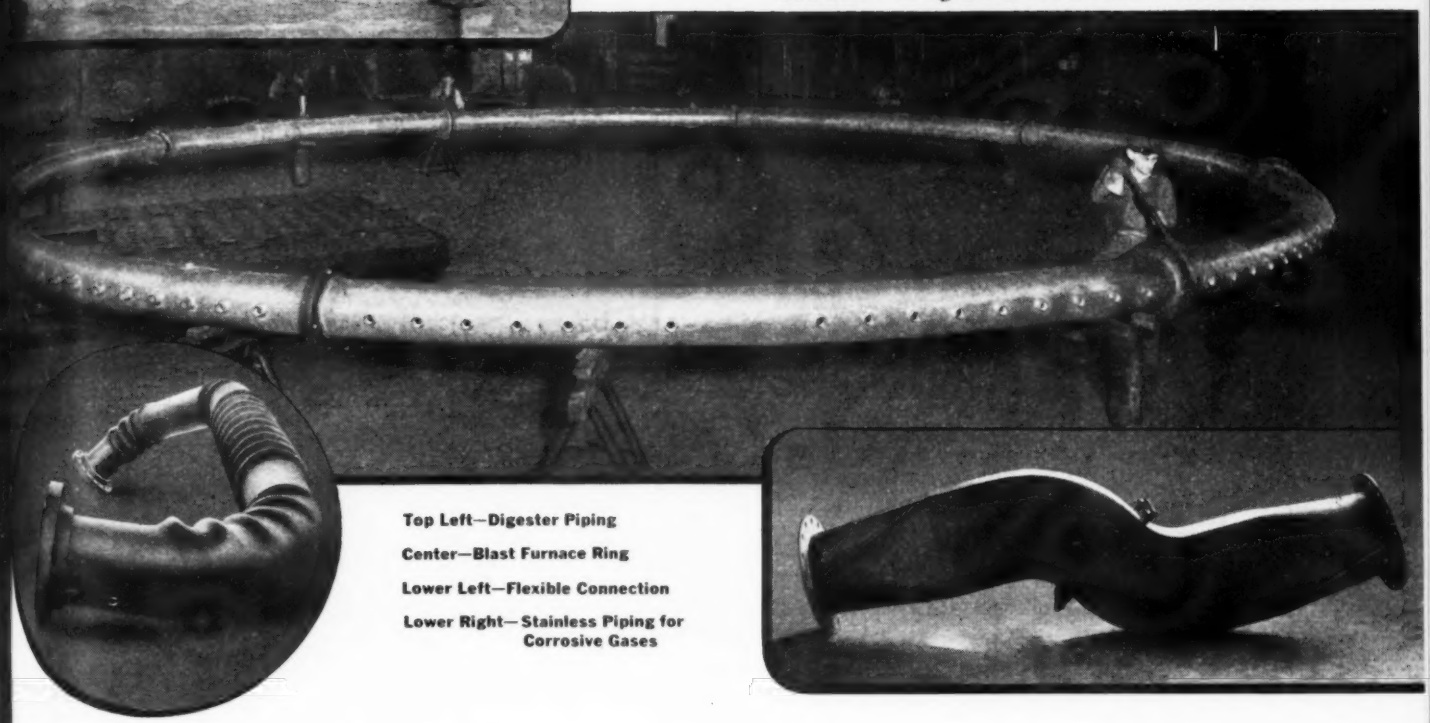

Top Left—Digester Piping

Center—Blast Furnace Ring

Lower Left—Flexible Connection

Lower Right—Stainless Piping for Corrosive Gases

PITTSBURGH Piping & Equipment Company is equipped to pre-fabricate and erect ALL of your piping requirements, regardless of size, shape, or material, from single assemblies to complete piping systems. An experienced engineering staff to supervise and facilitate production from the blueprint stage to final operation; modern equipment for bending, welding, flanging, Van Stoning, machining, heat treating and hydraulic testing; crews of trained men who are experts in every phase of piping fabrication, insure the utmost accuracy of dimension.

By pre-fabricating assemblies as large as shipping and installation facilities will permit, testing, insurance inspection, and final erection of field installation is simplified and expedited, thereby saving both time and material.

Pittsburgh Piping & Equipment Company's successful experience of over 40 years, plus their modern facilities and trained personnel assure prompt, efficient service, and dependable installations. If you need a single pipe or complete system, address your nearest Pittsburgh Piping & Equipment Company office listed below or contact our engineering department direct.

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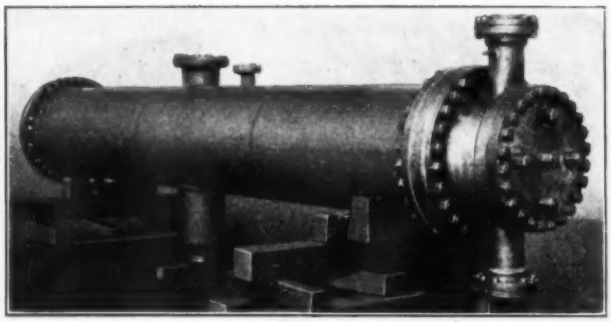
WHITLOCK

HEAT TRANSFER

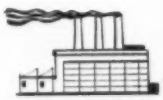
EQUIPMENT



WHITLOCK Type "SF" Extraction Feed Water Heater for pressures up to 600 lbs. per sq. in.

Extraction Type

FEED WATER HEATERS



WHITLOCK Feed Water Heaters of Extraction Type are widely used in central stations and the larger private power plants to preheat boiler feed water by steam extracted or "bled" from different stages of the steam turbine. Generally, these extraction heaters are designed to raise the temperature of the water about 100°—where higher ranges are wanted, heating is done in two or more stages.

for High Pressures

Today's high pressure plants require high pressure heaters: WHITLOCK Extraction Feed Water Heaters, Type "RF" with U-bends or Type "SF" with straight tubes, are in extensive use for service of this kind.

Bring your heat exchanger problems to WHITLOCK. Our trained staff of engineers will be pleased to make recommendations and can advise you regarding the necessary procedure for purchasing heat exchangers in accordance with WPB regulations.

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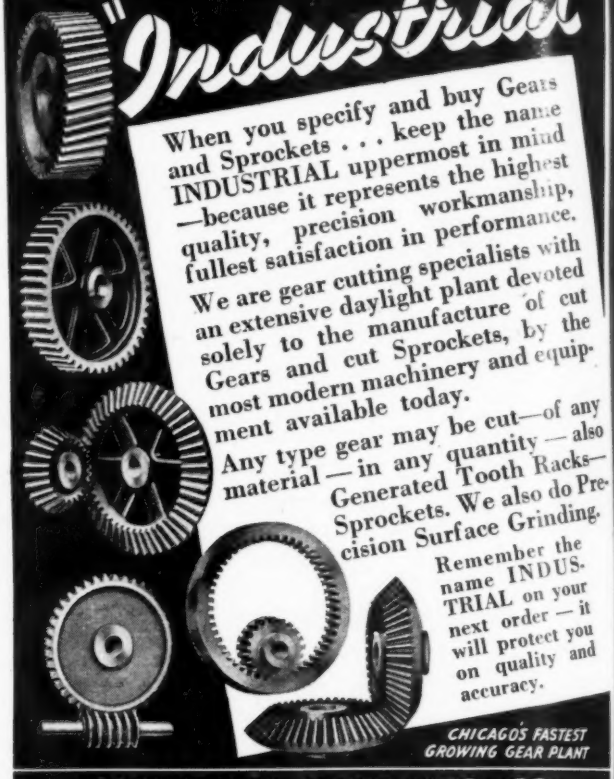

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Wrought Iron

1. Q. What filler metal should be used?

A. In welding wrought iron best results are gained by using a standard mild steel filler metal or a rod containing small percentages of alloying elements. These rods are preferred over wrought iron filler metal where welds of high corrosion resistance are required.

2. Q. When the metal first appears molten, is it ready to weld?

A. Fusion of the slag content in wrought iron at about 2100°F gives the metal a deceptive molten appearance. However this is far below the proper welding heat of 2700°–2770°F. Therefore the flame or arc should be applied until a puddle of molten metal appears. This molten puddle should be maintained while filler metal is applied.

Galvanized Steel

1. Q. How may galvanized steel be welded to have a minimum burning away of the galvanized coating?

A. To obtain this result galvanized steel should be oxyacetylene braze-welded with Airco No. 22 manganese-bronze rod, and Airco Hi-Test Brazing Flux. Fusion welding by flame or arc with steel welding rods or electrodes is likely to destroy the galvanizing near the weld and expose the base metal to corrosive attack.

2. Q. How should flux be used?

A. Airco Hi-Test Brazing Flux should be applied to both sides of galvanized parts, and to inside and outside of pipe and fittings. The flux application stops zinc fuming and thus preserves the galvanized coating under the welding heat.

HERE'S YOUR "KNOW HOW" GUIDE FOR WELDING MANY METALS

Procedures for welding most commercial metals are given in the Airco manual, "Welding Procedures". Welding novices and even experts will find much valuable information both on methods and materials recommended for best results. Send for your free copy by filling out and mailing the attached coupon..

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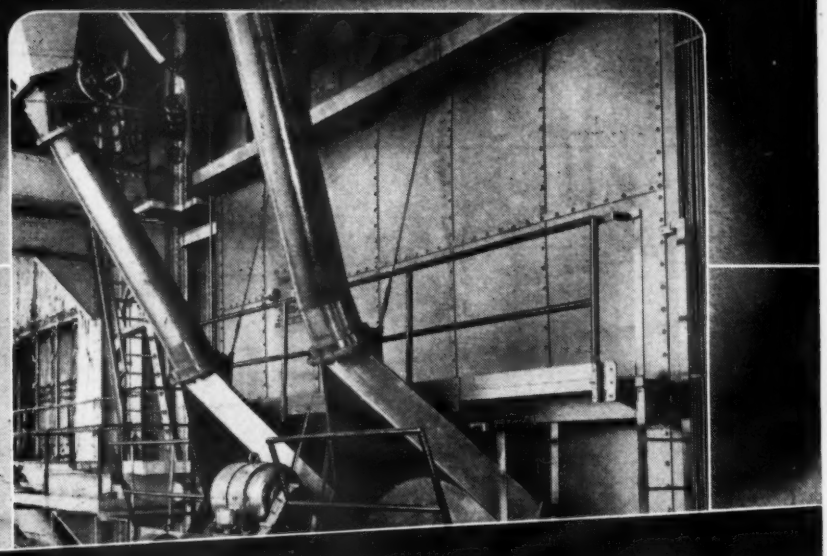
WHAT? Stokers in the Turbine Room?



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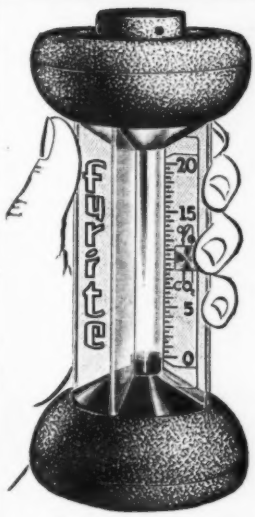

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With America's war production goals requiring practically continuous operation of boilers at maximum capacity—it is vitally necessary to control your chimney losses. The FYRITE "Orsat" CO_2 Analyzer makes accurate flue gas tests easy. It is simple, rugged, cold-weather proof—has no valves, clamps, or leveling bottle; no glass parts or batteries. 7000 FYRITES are in service.

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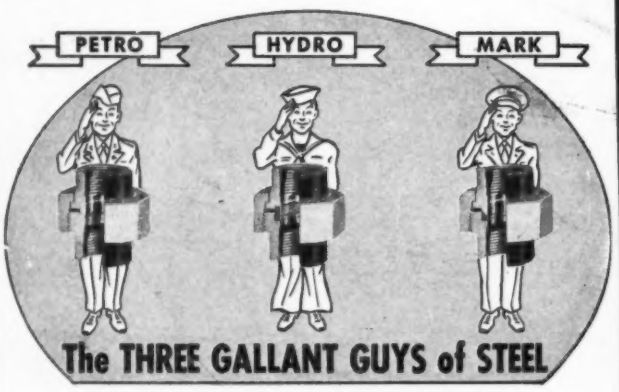

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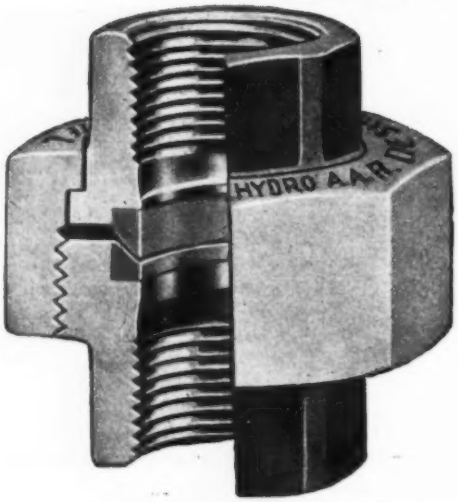

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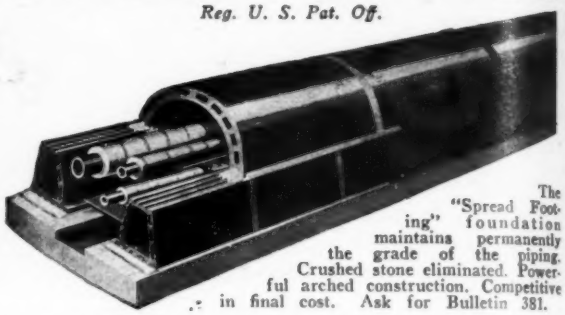
Reg. U. S. Pat. Off.



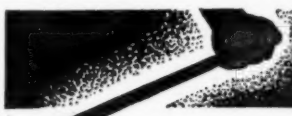
The "Spread Footing" foundation maintains permanently the grade of the piping. Crushed stone eliminated. Powerful arched construction. Competitive in final cost. Ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.
827P Frelinghuysen Ave. Newark, New Jersey

Without obligating us in any way, ☐ Please send Bulletin 381. ☐Send representative. ☐ Enclosed is a sketch, with principal data of a prospective job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Clip your name, firm, and address to this ad; tear out with the checked squares above, mail; and you will hear from us promptly.



TAL'S Prestal
HYDRAULIC PORTABLE PIPE BENDER

for iron and steel pipe from ⅜" to 4½"

- **No Heating**
- **No Filling**
- **No Kinks**
- **No Wrinkles**

The NEW TIME-SAVING, LABOR-SAVING MACHINE that ELIMINATES EXTRA WORK!

Why use fittings, elbows, etc., in places where they are not necessary? Make your job easier—faster—less complicated and at the same time save critical materials.

Those who use TAL'S PRESTAL once, never again go back to old, time-wasting methods.

Use it for all types of plumbing and heating.

TAL'S PRESTAL is portable — goes along on every job—is so easy to operate that even "green hands" will turn out smooth, wrinkle-free bends in one single, simple operation requiring only a few minutes.

SMOOTHNESS OF BENDS:
No breaking of pipe due to scientific development of bending formers. No job too complicated.

Obtainable in three different sizes.
Meets U. S. Navy, Army & Maritime Comm. Specifications.
Write today for circular giving complete description.

TAL'S PRESTAL BENDER, Inc. Dept. P-10 Milwaukee, Wisc.

WeldELLS *have everything* ★

"It's my job to find better ways—"

"A plant superintendent's tough job, as I see it, is to size up the facts and separate the something better from the so-called good enough. After all, there is only one *best* way to do a thing and it's my assignment to find it.

"Of course the difference between best and next best isn't so very great in some cases. But when it comes to welding fittings I think a cold appraisal will give a distinct edge to WeldELLS.*

"WeldELLS are basically sound from the start: Seamless—reinforced where stresses are greatest—engineered down to the last detail. Then, over on the practical side, they have everything it takes to speed up the job and cut costs. The clean machine tool bevels facilitate good welding and cut piping costs. Precision quarter-marks are a big help to the welder; and the permanent markings of size and weight on every WeldELL are nothing short of a must."

Yes, whether you are looking for safety, utility, convenience or economy—and who doesn't want them all?—you have in WeldELLS one of those rare products that offers you EVERYTHING!

★ **WeldELLS alone have all these features:**

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant ships and transports.

TAYLOR FORGE & PIPE WORKS
General Offices & Works:
Chicago, P. O. Box 485
New York Office: 50 Church Street
Philadelphia Office: Broad St. Station Bldg.

*WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

"TOLEDO"
#101
FULL MOUNTED
BOLT SET
¼" - ⅝" INCL.

YOU DO HAVE TO TRY THEM

Then you will be convinced that "TOLEDO" has the finest bolt threading tools on the market today.

The easy adjustment for deep, shallow or standard threads will appeal to you.

#101—⅛" to ⅝"
#102—⅛" to 1"

The segment dies with ample chip clearance and easy cutting that can be reground when dull—a distinct improvement.

JUST TRY ONE

THE TOLEDO PIPE THREADING MACH. CO.

TOLEDO, OHIO

NEW YORK OFFICE—502 #2 RECTOR ST. BLDG.

MANZEL FEEDERS MAKE BOILER COMPOUND GO FURTHER—DO A BETTER JOB

Because Manzel Chemical Feeders inject exactly the right amount of boiler compound on each pump stroke, a gallon of compound goes further. And because every gallon of water entering the boiler receives the same amount of chemical, the treating operation attains maximum effectiveness.

Feed on Manzel Chemical Feeders is easily adjusted, and once set the Feeder requires no further attention except to keep the chemical tank supplied.

Installed directly on the boiler feed pump, Manzel Feeders are positive and dependable in operation. Their simple design and sturdy construction insure years of trouble-free service.

WRITE FOR BULLETIN

MANZEL BROTHERS COMPANY 326 Babcock St., Buffalo, N. Y.

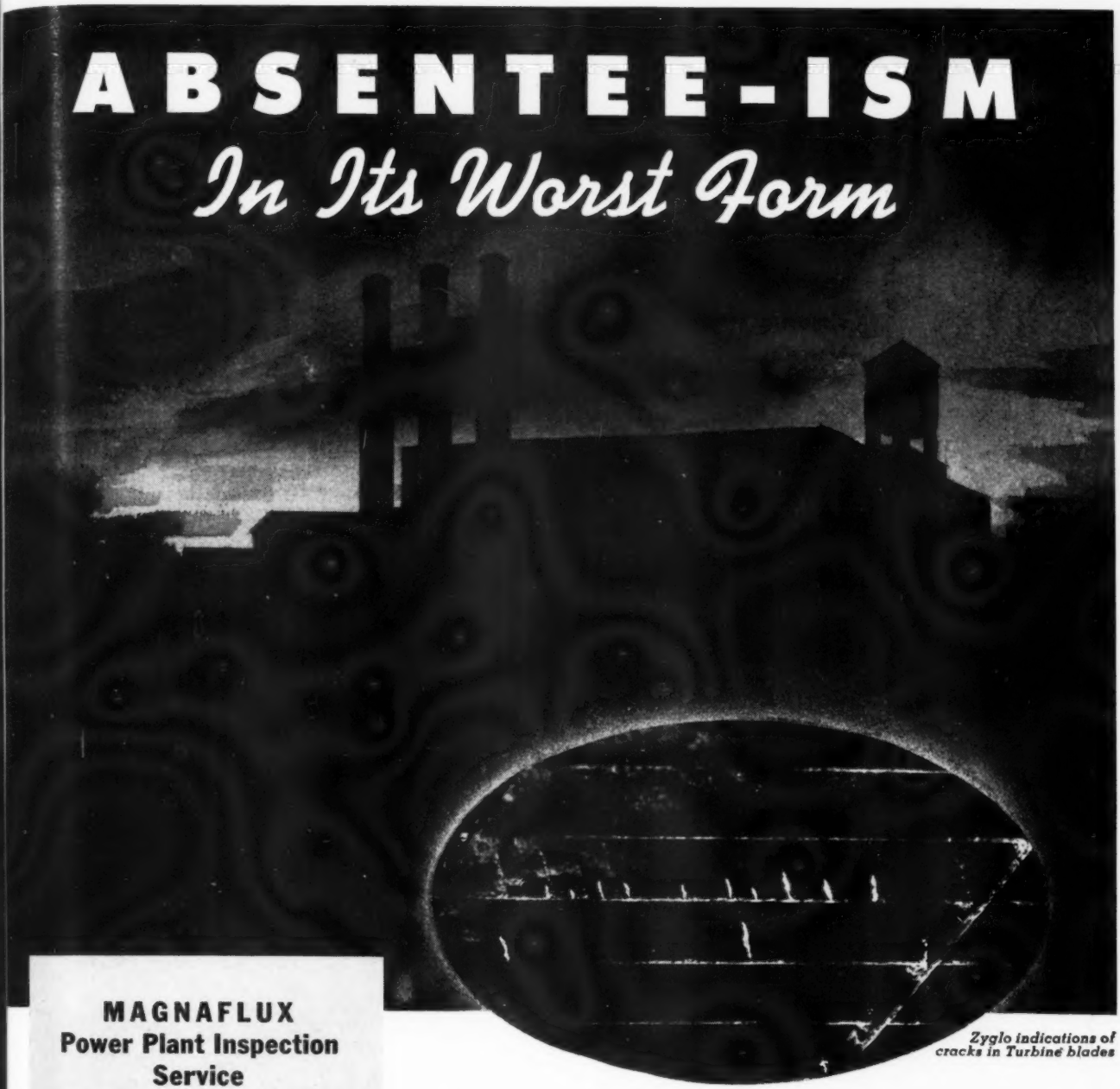
BROWNELL STOKERS

For those interested in a *good* stoker for plant, institution, office building, hotel, apartment or home, there's a Brownell Underfeed to suit your requirements up to 500 h.p. with single retort—larger industrial sizes with twin retorts.

Write for illustrated bulletin

THE BROWNELL COMPANY
The World Over
SINCE 1858
DAYTON, OHIO, U.S.A.

ABSENTEE-ISM
In Its Worst Form



Zyglo indications of cracks in Turbine blades

MAGNAFLUX
Power Plant Inspection Service

3 METHODS

MAGNAFLUX *
Magnetic Particle Inspection

MAGNAGLO *
Fluorescent Magnetic Particle Inspection

ZYGLO *
Fluorescent Non-Magnetic Inspection

When one power unit goes out, the loss is like a war worker's unnecessary absence from his job—except for two factors which make it far worse—(1) the whole power plant may stand cold and idle, and (2) it might have been prevented!

Magnaflux Inspection Service offers a consistent preventive program. First, it confines the power loss to "planned outages" such as periodic teardown and overhaul—tends to eliminate breakdowns, accidents and shutdowns with all the added losses of emergency conditions. Second, it cuts hours and days from the actual inspection routine.

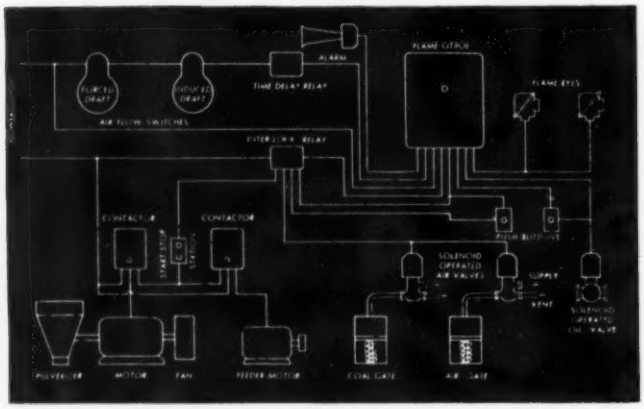
Three Magnaflux Methods enable a Magnaflux field engineer to speed inspections of turbine blades, boiler shells, and every power unit subject to fatigue cracks . . . under a great variety of lighting conditions, inaccessibility of parts and types of material—bronze, steel, aluminum, iron, brass, plastics, porcelain, etc. The high degree of accuracy developed in these methods promises unusual freedom from trouble for long periods.

**Registered Trade Names covering the methods, materials and equipment of Magnaflux Corporation*

MAGNAFLUX CORPORATION
5920 Northwest Highway, Chicago 31, Illinois
NEW YORK • DETROIT • DALLAS • LOS ANGELES • CLEVELAND • BIRMINGHAM

COMBUSTION SAFEGUARD

for Combination PULVERIZED COAL and OIL BURNER PROTECTION



Combination pulverized coal and oil burner protected by Wheelco Flame-otrol with complete purging cycle and safety shut-off features.

The Wheelco Flame-otrol (Electronic Combustion Safeguard) operates with equal efficiency on gas, oil, powdered coal, or any combination of these fuels. The Flame-otrol eliminates explosion hazards by preventing fuel and explosive product accumulation in the combustion chamber. Fuel, to the burner, is shut off instantly upon flame failure, or should any condition develop within the instrument itself, which might interfere with its operation. It also offers definite protection against carelessness and negligence of inexperienced operators. Flame-otrols are available with automatic or manual ignition, time delay for purging, or other desirable sequences. ***Request Bulletin L-2***

Wheelco Instruments Co.

863 W. HARRISON STREET • • • CHICAGO 7, ILLINOIS

"Electronic Principle" Temperature Controls

GATX GENERAL AMERICAN

PLATE & WELDING DIVISION

PLANT AT SHARON, PA.

Steel plate fabricators

Manufacturers of Class I pressure vessels and all other classes of welding

Complete X-ray and annealing facilities

Completely equipped department for field erection

TODAY—Devoted 100% to War Production

TOMORROW—At Your Service

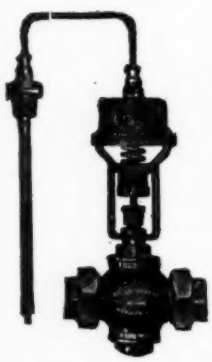
Plate and Welding Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

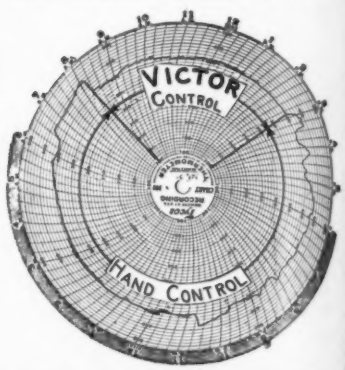
SHARON, PA.

TEMPERATURE REGULATORS

VICTOR



At the left we show a typical VICTOR Regulator. This one is equipped with a balanced type, double seat valve, and seamless metal bellows. It is recommended for controlling the temperature of liquids in open or closed tanks, for heaters, condensers, gas coolers, retorts, desuperheaters, etc. Both bulb and control valve will operate in either a vertical or horizontal position. Also available with single seated control valves for fuel oil heaters. Separate bulb sockets of brass or acid resisting metals are furnished at additional cost. Sizes ½" to 2½". Complete information on request.



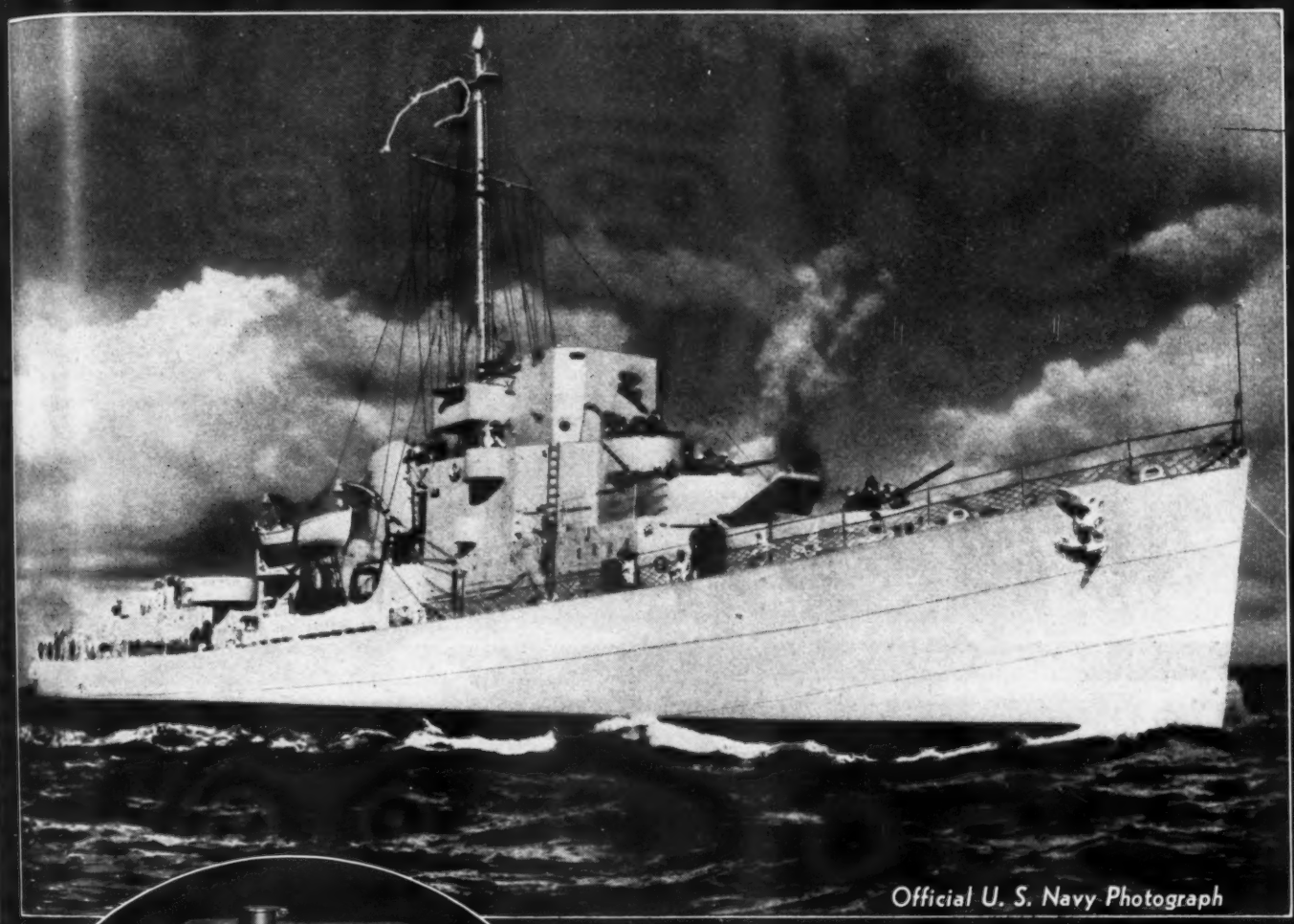
Reasons why YOU should adopt VICTOR Regulators are clearly shown in the typical diagram at the right. Here the VICTOR maintained 380° F. for 7 hours. Note what happened during the remainder of the day under Hand Control. Complete data on request.

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

280 South St., Newark, N. J. *Representatives in Principal Cities*

WOODWARD



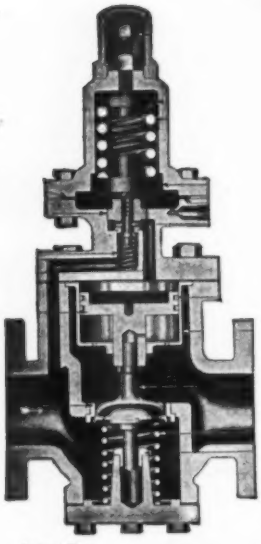
Official U. S. Navy Photograph

● The United States Navy uses WOODWARD Type SI Torque-limiting Hydraulic Governors for the control of propulsion engines on Destroyer-Escort Vessels.

WOODWARD GOVERNOR CO.

WORLD'S OLDEST AND LARGEST EXCLUSIVE MANUFACTURERS OF HYDRAULIC GOVERNORS FOR PRIME MOVERS

ROCKFORD, ILLINOIS



Type 470

Got a Control Valve Problem?

CALL ON K & M

War has curtailed our civilian manufacturing—and multiplied the difficulties of your job. But don't let it get you down. If you have a problem involving pressure or fluid control—an installation, operating or maintenance problem—we can save you days of work and worry. Call on our new VALVE PROBLEMS CLINIC. All the know-how of 65 years of specialization is yours for the asking . . . no charge, no obligation, no red tape. Whether or not you are using K & M equipment . . . we invite you to CALL ON K & M.

K & M PILOT OPERATED REGULATING AND REDUCING VALVE—*providing dependable close regulation for any difficult reduction service. The pilot action assures accuracy regardless of inlet pressure variation. Shuts off tight in dead end service. Built for initial pressures up to 600 lbs.—with reduced pressure ranges of from 2 lbs. to 80% of the inlet pressure. Sizes 2" to 12".*

KM KIELEY MUELLER ESTABLISHED 1879

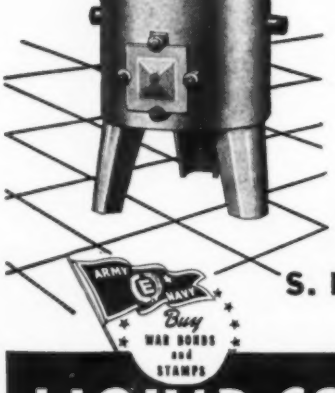
Kieley & Mueller

ENGINEERED PRESSURE & FLUID CONTROL SPECIALTIES

NORTH BERGEN, NEW JERSEY

Representatives in all Principal Cities

BOOST THE PRODUCTION OF YOUR CENTERLESS GRINDERS



This has been referred to as a grinding war . . . and surely grinding is playing a vital part in war production. How one important producer of war materials solved a perplexing grinding problem may help you. After building larger machine sumps, changing the grades of grinding wheels, adjusting machines and speeds, the problem was still not licked. Finally a Bowser Grinding Oil Filtration system was installed with the phenomenal results listed at the right.

If you have a cutting oil, grinding, honing, threading or similar problem call Bowser. Perhaps it can help you, too.

A Typical EXAMPLE OF WHAT A WAR PLANT ACCOMPLISHED WITH BOWSER FILTERS

- ★ 27% INCREASE IN PRODUCTION
- ★ 80% REDUCTION IN WHEEL DRESSINGS
- ★ 42% DECREASE IN SCRAP
- ★ LOWER DIAMOND COSTS
- ★ IMPROVED PRECISION MANUFACTURE
- ★ VITAL MAN POWER SAVED

BOWSER ESTABLISHED 1885

ARMY NAVY Buy WAR BONDS and STAMPS

S. F. BOWSER AND COMPANY, INC.

FORT WAYNE, INDIANA

LIQUID CONTROL SPECIALISTS SINCE 1885

METERING • DISPENSING • STORING • LUBRICATING • FILTERING • DISTILLING

WHAT THE ENGINEER SAID TO THE BOSS!

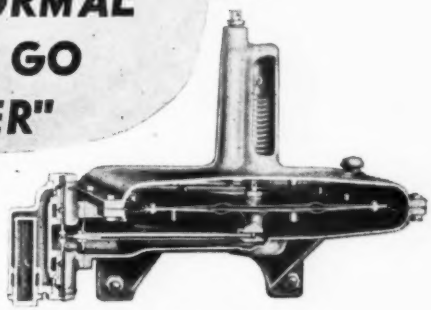
"NO SIR, WE WON'T REQUIRE MORE FUEL ... WE'LL NOW GET THAT ADDED STEAM CAPACITY BY MAKING OUR NORMAL SUPPLY GO FARTHER"

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

As soon as CASH STANDARD Automatic Control Systems are installed, engineers make observations important to the boss. They see that the boilers stretch in capacity. That more heat is produced from less fuel. That there is considerable savings in fuel (coal, oil, or gas). That operating efficiency is increased. That attendance time is cut.

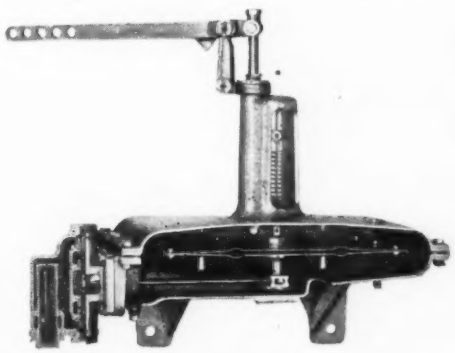
It all results because a CASH STANDARD Automatic Combustion Control System makes possible correct fuel feed, proper air supply, and constant over-fire draft in plants as small as 60 h.p or as large as they come.

Bulletin No. 300 gives you full details on applications and operations. Write for a copy.



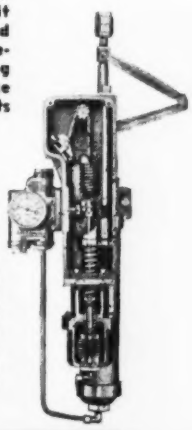
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

If you work with steam, get this

NEW *Strong* TRAP HANDBOOK!

VALUABLE INFORMATION AT YOUR FINGERTIPS

HERE ARE *Quick* FACTS YOU'VE BEEN WANTING!

Concise, clear-cut information streamlined for busy designing and operating engineers. Easy ways to select and size traps —steam tables—piping diagrams—information you need every day to save time and get results.

You'll find the complete Strong trap line for low, medium and high pressures . . . open and inverted bucket and float traps, types for special services.

Write today for Strong Trap Catalog No. P-143

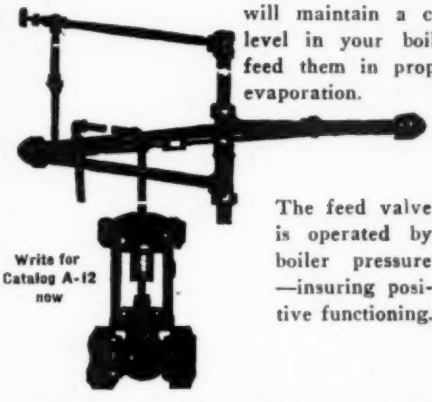
Strong, Carlisle & Hammond Co., Cleveland, Ohio

STRONG
STEAM SPECIALTIES

For Safe Boiler Operation

The Genuine Squires

Boiler Feed Water Controller



will maintain a constant water level in your boilers and will feed them in proportion to the evaporation.

Write for Catalog A-12 now

The feed valve is operated by boiler pressure —insuring positive functioning.

Trade Mark Reg. U. S. Patent Office

THE C. E. SQUIRES COMPANY

East 40th St. and Kelley Ave., Cleveland, Ohio

SAFE-LINE

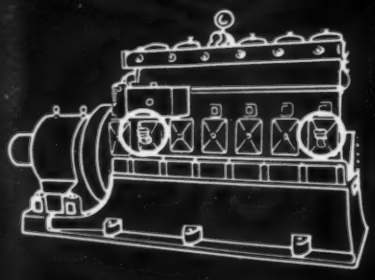
WIRE ROPE CLAMPS

Write for details of this—the only PERFECTED wire rope clamp on the market. Used by the Armed Forces and thousands of industries.

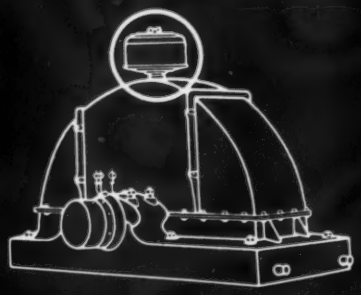
NATIONAL PRODUCTION COMPANY

4523 ST. JEAN AVENUE DETROIT 13, MICHIGAN

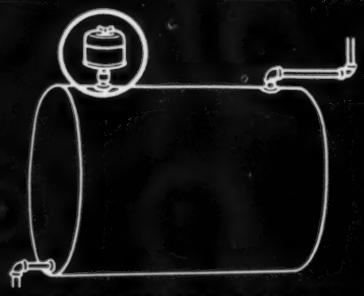
GIVE 'EM AIR..clean air!



TWO AIR-MAZE BREATHER-FILTERS INSTALLED ON CRANKCASE OF 9 CYLINDER GAS ENGINE

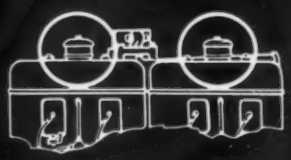


TYPICAL APPLICATION OF AIR-MAZE GEAR CASE BREATHER

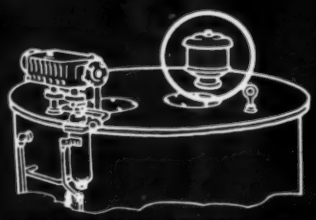


LIQUID STORAGE TANK, PROTECTED BY AIR-MAZE BREATHER AND FLAME ARRESTER

AIR-MAZE BREATHERS VENT CRANKCASE OF BOTH ENGINE AND COMPRESSOR IN THIS INSTALLATION



VALVE HOUSINGS ON ENGINE ARE VENTED BY TWO AIR-MAZE BREATHER-FILTERS



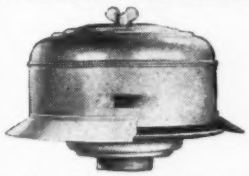
HYDRAULIC PRESS, EQUIPPED WITH LARGE AIR-MAZE OIL-BATH TYPE BREATHER-FILTER

One reason for covering up important machinery and for storing liquids in closed tanks is to keep them clean. Open vents in these enclosures invite dirt and contamination.

Vents protected by Air-Maze breather filters, however, let air pass, but stop dirt. Used on crankcases of engines and compressors, gear cases, hydraulic equipment and machinery housing, they help keep lubricants clean and prevent needless wear. On liquid storage tanks they capture undesirable substances, and act as efficient spark and flame arresters. (Air-Maze breather filters are approved by Factory Mutual Laboratories as flame arrestors for tank vents.)

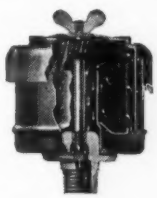
Both oil-wetted and oil-bath types are available in many sizes and designs. Air-Maze representatives will gladly assist you in specifying the correct size and type for your needs. Nearly 20 years of experience in solving air-venting problems are at your disposal without obligation.

TYPICAL AIR-MAZE BREATHER FILTERS



Drip pan collects condensed oil vapors in this model.

Standard model commonly used on automotive crankcase breather pipes.



Cutaway view of oil bath type breather, used where dust conditions are severe.

Oil-bath type for use on oil-fill pipe. Oil added to crankcase by lifting top of breather.

AIR-MAZE CORPORATION • ***Engineers and Manufacturers*** • **CLEVELAND 5, OHIO**

AIR-MAZE

SPECIALISTS IN AIR FILTRATION

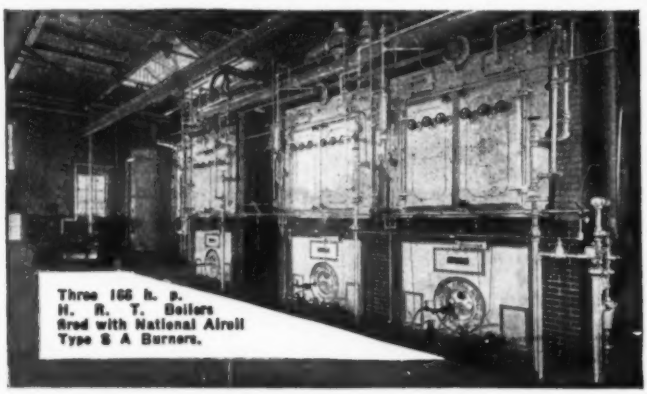
Get Complete Atomization and Efficient Combustion

of even Lowest and Cheapest grades of oil and tar . . . .

with Type SA

NATIONAL AIROIL BURNERS

These burners which can be used wherever steam or compressed air is available for atomization, can be operated with low oil pressure and low oil temperature. Operate continuously without clogging or cleaning. Capacity range from 25% to 150% of burner rating. Five sizes with rated capacities from 10 to 200 g. p. h.



Three 166 h. p. H. R. T. Boilers fired with National Airoil Type S A Burners.

We have 31 years specialized experience and a complete line of burning equipment that can help meet your needs for burning oil or gas separately or in conjunction with pulverized coal.

NATIONAL AIROIL BURNER COMPANY, INCORPORATED
1250 East Sedgley Avenue
PHILADELPHIA 34, PENNA.

OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS
• EXPLOSION DOORS • ACCESS DOORS • AIR DOORS
• BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

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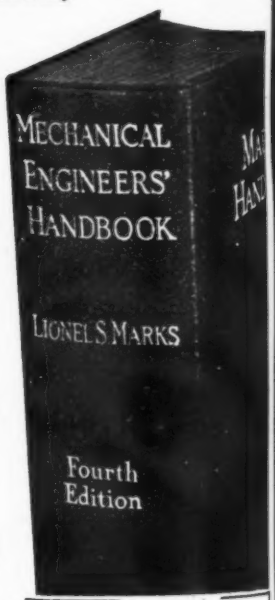

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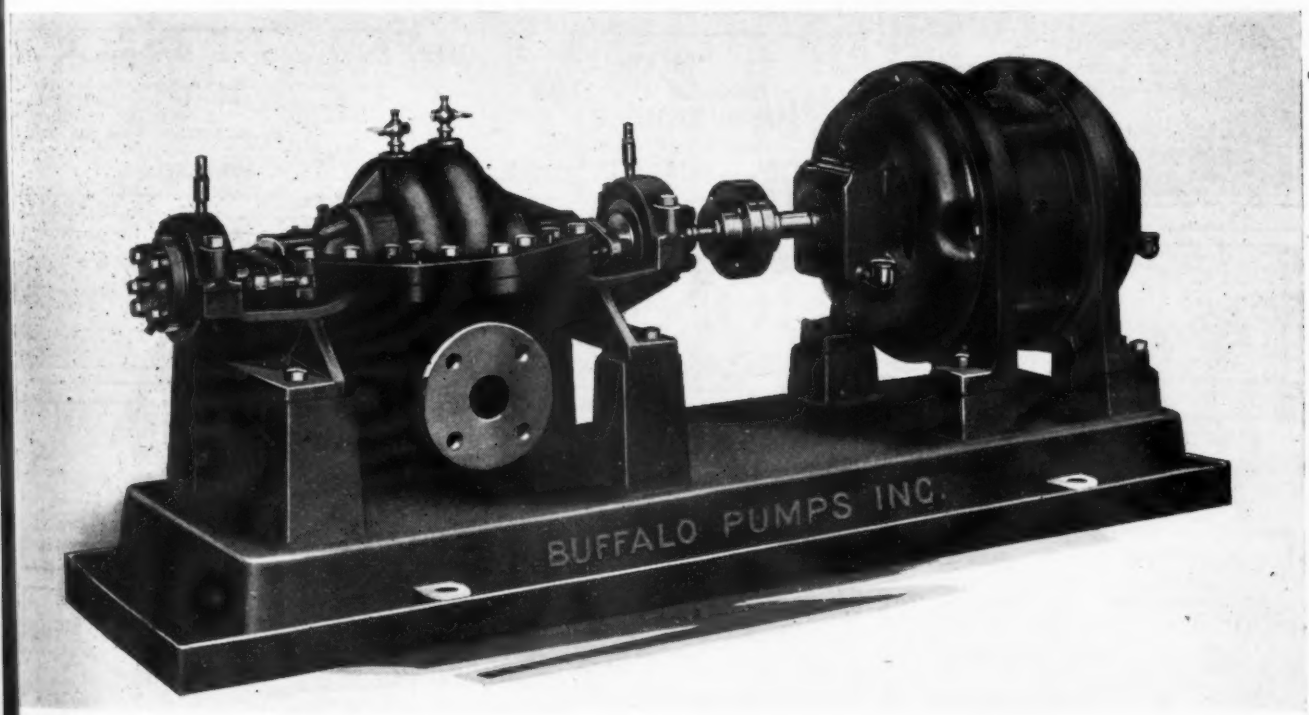

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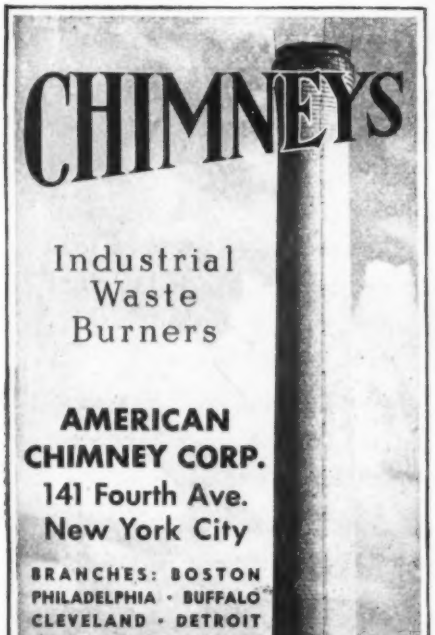

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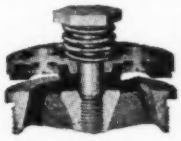

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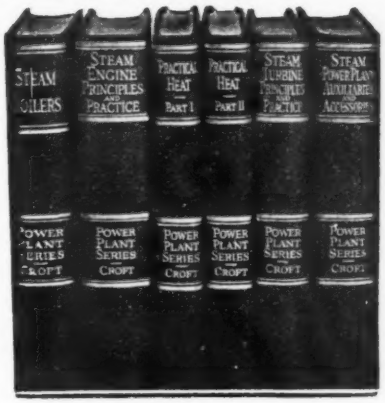
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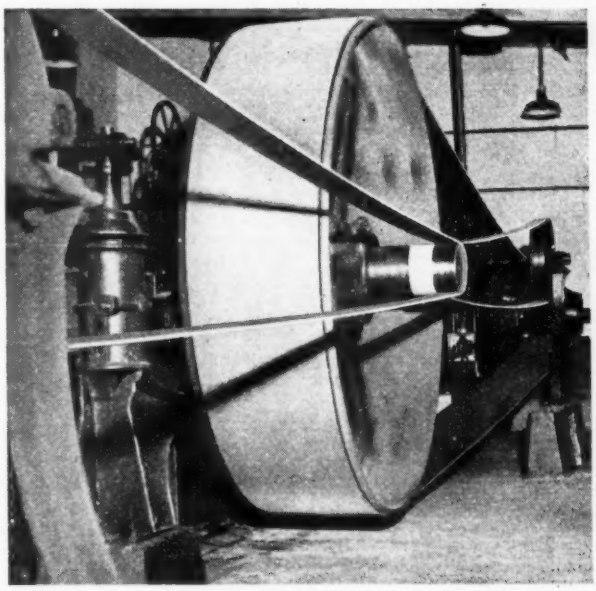

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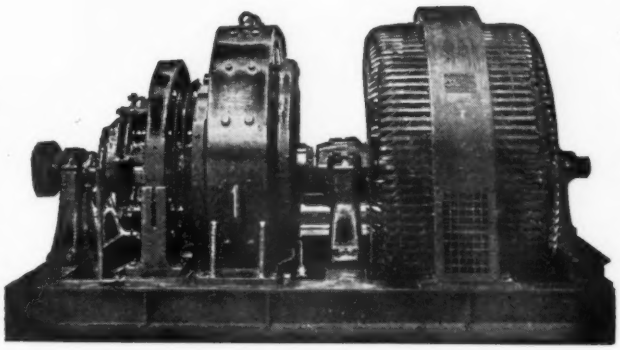

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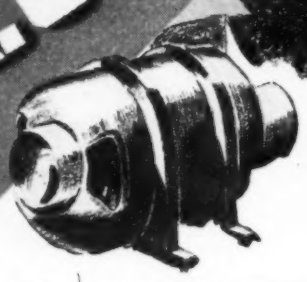

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H.P.	Make	Speed
200	G. E.	600
150	West.	1170
147	West. 25 cyc.	715
100	G. E.	1160
100	G. E.	870
100	West.	690 (2)
100	G. E.	580
100	G. E. (BTA)	375/750 (2)
75	West.	870
50	West.	1160
50	G. E.	690
50	Cr. Wh.	490
40	El. Dy.	1150
40	G. E.	870
40	Triumph	690
35	Wagner	850
30	U. S. (Vert.)	3450
30	West. (Vert.)	1750
30	Watson 25 cy.	1450
30	Al. Ch.	850
30	El. Dy.	680
30	Al. Ch.	580
30	G. E.	490
25	G. E.	1150
25	Wagner	1150
25	El. Dy.	1150
25	West.	1140
25	Wagner	1160
25	Diehl	865 (4)
25	West.	870
25	G.E.	870
25	G. E. 25 cy.	750
25	Wagner	720
25	Westing.	700
20	El. Dy.	1150
20	Al. Ch.	1750
20	G. E.	1750 (2)
20	G. E.	1150
20	G. E. Vert.	1150 (2)
20	F. M.	1150
20	Cr. Wh.	1150

3 PHASE SQUIRREL CAGE—Continued

H.P.	Make	Speed
20	West.	1140
20	Al. Ch.	860 (4)
20	F. M.	870
20	Diehl	865 (3)
20	G. E.	870
20	G. E.	690
20	R. & M.	690
20	West.	690
15	G. E.	3600
15	Burke	1800
15	G. E.	1750 (1)
15	Cr. Wh.	1720
15	G. E.	1160
15	Al. Ch.	1160 (3)
15	Cr. Wh.	1140
15	G. E.	1120
15	G. E. Vert.	1150
15	G. E. Vert.	870
15	West.	850
15	Al. Ch. 25 cy.	750
15	Wagner	720
15	Watson 25 cy.	750
15	G.E.	580
14½	G. E.	980
12	G. E.	690 (8)
10	G. E.	3450
10	El. Dy.	1150
10	Al. Ch.	1150 (2)
10	West.	1120
10	G. E. Vert.	870
7½	Al. Ch.	1750
7½	R. & M.	1750
7½	G. E.	1640
7½	West. 25 cy.	1460
7½	G. E.	1150
7½	West.	1130
7½	West.	970
7½	G. E.	870
7½/3¾	G. E.	1800/900
6	G. E. Vert.	6/9/12/1800
5	West.	1700
5	G. E. (BTA)	550/1650
5	West.	1150
5	G. E.	1150
5	West.	840 (2)
3	El. Dy. Vert.	1750 (2)
3	Ideal Vert.	1750 (2)
3	Wagner Vert.	1140
3	G. E.	400
3	G. E. Vert.	1150
3	G. E. Vert.	1160
3	West. 25 cy.	1160
3	Master 25 cy.	710
3	G. E. 25 cy.	286
3	Steri. vert.	190
3	Steri. Vert.	110
2½	West.	1020
2	G. E.	3600
2	Louis Allis	1150

3 PHASE SQUIRREL CAGE—Continued

H.P.	Make	Speed
2	G. E.	1150
1¼	G. E.	6/9/12/1800
1½	G. E.	3500 (5)
1½	El. Dy.	3600
1½	El. Dy.	1800 (2)
1½	Master	1800
1½	Wagner 25 cy.	1450
1½	El. Sp.	1150 (3)
1½	G. E.	12/900 (4)
1	G. E.	3600
1	G. E.	1800
1	Watson	1720
1	G. E. Vert.	1710
1	Del.Ver.25 cy.	1435 (2)
1	Diehl	1140 (3)
1	Ideal	1150
1	G. E.	12/900 (10)
1	G. E.	6/9/12/1800
1	Master 25 cy.	321

2 PHASE SQUIRREL CAGE

H.P.	Make	Speed
75	Cr. Wh.	870
50	Linc.	870
50	G. E.	870
50	Al. Ch.	870
40	G. E.	870
40	Al. Ch.	870
40	F. M.	870
40	Cr. Wh.	870
35	Al. Ch.	870
30	West.	1150
25	G. E.	1150 (3)
25	West.	1150
20	El. Dy.	1750 (2)
20	West.	1160
20	Star	1150
15	West.	3450
15	West.	1150
15	G. E.	1150
15	Cr. Wh.	1140
15	F. M.	870
10	West.	1150
10	G. E.	1150
10	El. Dy.	1140
10	G. E.	870 (2)
7½	G. E.	865
7½	G E. (BQ8)	600/1350 (2)
5½	G. E.	870
5	G. E. 25 cy.	1500
5	West.	1130
5	Al. Ch.	1140
3	West.	870
2	West.	1130
1¾	L. All.	
1½	G. E.	1800
1	West.	1700 (2)
1	Cr. Wh.	1700
1	G. E.	1150
1	Howell	870
½	Hobart	1700
½	Kimball	1750
½	Cr. Wh.	1150
¼	Star	1750
¼	El. Sp.	3400 (8)
¼	Wing	1150
⅛	G. E.	1140
⅛	G. E.	1200 (3)
⅛	G. E.	1725

2 & 3 PHASE SLIP RING

H.P.	Make	Speed
500	Al. Ch.	1180
250	G. E.	600
200	West.	580
200	G. E.	495
150	Al. Ch.	695
125	West.	1175
125	Burke	580
112	G. E.	690
100	F. M.	690
79	West.	1170
75	West.	1170
75	Al. Ch.	575
64	G. E.	585
60	West.	1135
60	West.	290
50	Ideal	1740
50	G. E.	870 (2)
50	West.	850
40	Wagner	1150
40	F. M.	870 (2)
40	West.	870
40	Linc.	690
30	G. E.	870
30	G. E.	690
15/35	West.	6/1200 (5)
25/55	G. E.	6/1200
20/50	West.	6/1200
25	Al. Ch.	870 (2)
25	Burke	870
25	West.	850
25	Howell	870
25	G. E.	870 (2)
25	G. E.	720
25	West.	575
20	G. E.	870
20	West.	575
15	G. E.	845
10½	G. E.	780
10	G. E.	1150
10	Al. Ch.	1150
7½	Triumph	850
7½	G. E.	870 (2)
7½	Howell	720
5	Wagner	1140
5	G. E.	1150
5	G. E.	870
5	Northern	1090
3	West.	1160
3	G. E.	870
3	West.	870
2	G. E.	870
1½	G. E.	1150 (12)
1½	West.	1140 (12)
1½	West.	870
1½/¾	El. Dy.	6/1200
	Kimball	1150
1	G. E.	1150;(6)

SPECIAL

500 H.P. AL. CH.
Slip Ring, 3 ph.
2300 V, 1180 RPM.

SYNCHRONOUS MOTORS

H.P.	Make	Speed
50	Cr. Wh.	1800

550 V. DC.

H.P.	Make	Speed
25	G. E.	875
20	G. E.	895
15	G. E.	1350
7½	G. E.	900
3¾	G. E.	5/1650
3	G. E.	1800
1½	G. E.	1750 (2)
1½	G. E.	500/1575
1	G. E.	7/1500
½	Eck	1600
½	G. E.	6/1875
¼	G. E.	1400

230 V. DC.

H.P.	Make	Speed
330	G. E.	1100
150	West.	600
60	Roth	600
60	G. E.	480 1100 (3)
50	West.	550/1100
50	Cr. Wh.	700 (2)
50	G. E.	660
50	G. E.	850
45	Diehl	850/1030
45	G. E.	1800
40	G. E.	975
40	Cr. Wh.	915
40	P. & H.	Hoist
35	West.	1150
35	G. E.	440/800
30	West.	975
30	West.	1025
30	West.	500/1500
25	Diehl	850/1030
25	G. E.	1150
25	Al. Ch.	1150
25	Rel.	850
25	G. E.	700
25	G. E.	575
20	Cr. Wh.	1750
20	G. E.	1200/1600
20	R. & M.	1160
20	G. E.	1150 (4)
20	West.	1150 (2)
20	West.	975
20	G. E.	800
20	Al. Ch.	625
19	West.	1300 (3)
17½	Spr.	750
15	Star	1450
15	West.	1250
15	G. E.	1250
15	G. E.	1150 (5)
15	Eck	1100
15	Cr. Wh.	900/1800
15	West.	8/1600
15	West. Sk.	750
13	Nat.	1100
10	G. E.	850 (3)
10	West.	850 (3)
10	G. E.	700
10	Diehl	750
10	West.	600/1200
10	G. E.	400/1600
10	West.	400/1200
9	L. All.	1750
8½	Diehl	900

NEW YORK CITY'S
LARGEST STOCK OF
ELECTRICAL MACHINERY

L.J. LAND AN

D.C.

O.P.A. guarantee only 90 days

230 V. DC.—Continued

H.P.	Make	Speed
8¼	West.	850
8½	West.	350/1400
8	Cr. Wh.	910
8	G. E.	500/1500
7½	G. E.	Crane
7½	L. All.	Baier
7½	Sturt.	3600
7½	Peerless	1750 (2)
7½	West.	1450
7½	G. E.	1150 (2)
7½	West.	1150 (4)
7½	West.	975
7½	Cr. Wh.	900
7½	West.	850
7½	Al. Ch.	850 (3)
7½	Niles	Hoist
7½	El. Dy.	5/1650
7½	Watson	5/1150
7½	G. E.	450/1800
7½	G. E.	400/1600
7½	Al. Ch.	350/1050
7½	G. E.	3/1200
6	G. E.	400/1600
6	Roth	1150
6	G. E.	850
6	G. E.	450/1800 (2)
5¾	West.	850
5¾	West.	500/1500
5½	G. E.	Hoist
5½	G. E.	900
5½	G. E.	400/1600
5½	West.	500/1500
5	West.	1700
5	G. E.	1700 (2)
5	Rel.	1750
5	G. E.	1650 (2)
5	G. E.	1150 (9)
5	West.	1100
5	All. Ch.	1150
5	Cr. Wh.	1000
5	West	870/1750
5	Cr. Wh.	960 (4)
5	Spr.	950
5	West.	850 (2)
5	G. E.	850
5	Cont.	600/1800
5	Star	600/1200
5	El. Dy.	550/1650
5	G. E.	500/1000
5	G E.	450/1800
5	Northern	425/1275
5	G. E.	600
5	G. E.	450/1350
5	West.	400/1200
5	El. Dy.	275/1100
4	G. E.	850/1150
4	Diehl	1150
4	Northern	Hoist
4	Cr. Wh.	780 (2)
3½	Cr. Wh.	Hoist
3½	West.	975
3½	West.	850/1600
3½	West.	850 (2)
3½	Diehl	550
3½	El. Dy.	485
3	Watson	1750
3	G. E.	1750 (6)
3	West.	1750
3	R. & M.	1750
3	Star	1750
3	Spr.	1350
3	G. E.	1150
3	G. E.	1150 (6)
3	West.	1150 (4)
3	Cr. Wh.	1050
3	Master	1150
3	Star	1150
3	G. E.	850
3	Spr.	650
3	Roth	500/2200
3	G. E.	5/1500 (2)

230 V. DC.—Continued

H.P.	Make	Speed
2¾	West.	9/1800
2½	Watson	1300
2½	Diehl	7/1400
2½	West.	480/1800
2	G. E.	2500
2	R. & M.	2200
2	Watson	1800 (2)
2	R. & M.	1750
2	West.	1750
2	Rel.	1750
2	Diehl	1725
2	Burke	1700
2	Watson	1600
2	Cr. Wh.	1600
2	Spr.	1600
2	Cr. Wh.	1250
2	West.	1180
2	Watson	1150
2	Cr. Wh.	1150
2	G. E.	1150
2	Star	900 (2)
2	West.	850 (8)
2	Spr.	700/1400 (2)
2	Rel.	400/1200 (4)
1.8	Cr. Wh.	460 (2)
1½	G. E.	1700 (5)
1½	Watson	1750
1½	Roth	12/2400
1½	Cr. Wh.	1250
1½	El. Dy.	1200
1½	West.	1140
1½	Cr. Wh.	950
1½	West.	900 (3)
1½	Sturt.	850
1½	Diehl	800
1½	West.	260/1000
1¼	Cr. Wh.	550
1.2	Cr. Wh.	1175
1.1	Cr. Wh.	500 (2)
1	Eck	2400
1	Watson	1800
1	West.	1700
1	Cr. Wh.	1675
1	Eck	1450
1	West.	1140 (2)
1	Cr. Wh.	1335
1	N. Wst.	1300 (6)
1	G. E.	1275
1	G. E.	1150 (2)
1	Cr. Wh.	1200 (2)
1	Watson	900
1	G. E.	850
1	G. E.	575/1725
1	El. Dy.	600
1	C. & C.	520
1	Diehl	470
1	G. E.	450
1	Rel.	54

115 V. DC.

H.P.	Make	Speed
90	G. E.	900
20	West.	400/900
15	West.	1100
15	Cr. Wh.	800
10	L. All.	3500
10	G. E.	1150 (3)
10	West.	850
10	El. Dy.	425/1275
7½	West.	975
7½	G. E.	850 (2)
7½	Cr. Wh.	900
6	Burke	650
5	Cr. Wh.	1875 (2)
5	G. E.	1750
5	Col.	1500
5	West.	1100 (2)
5	Cr. Wh.	960
5	Cr. Wh.	600/1800
5	J. & L.	300/1200

115 V. DC.—Continued

H.P.	Make	Speed
4	R. & M.	1600
4	Cr. Wh.	535/1070 (2)
3¾	Diehl	475
3	West.	1725
3	G. E.	1550
3	G. E.	1150 (6)
3	West.	1150 (2)
3	G. E.	700/1200
3	Cr. Wh.	625
3	G. E.	500/1500
2½	Eck	1150
2½	N. E.	850
2½	Diehl	850
2½	G. E.	450
2	G. E.	1750 (2)
2	Spr.	1150 (3)
2	West.	1200 (2)
2	Cr. Wh.	1150 (4)
2	G. E.	1150 (2)
2	Diehl	1125
2	G. E.	850
2	Eck	550/1050
2	Watson	525
2	A. L.	375
1½	G. E.	3400
1½	N. W.	3600
1½	G. E.	1700
1½	West.	1725 (2)
1½	West.	1250
1½	Al. Ch.	500/1500
1½	G. E.	900
1½	Rel.	600/1800
1	G. E.	3400
1	Burke	2200
1	G. E.	1700 (2)
1	Cr. Wh.	1750
1	R. & M.	1750
1	Del.	1750
1	Cr. Wh.	1675 (2)
1	G. E.	850 (3)
1	G. E.	585
1	Diehl	450
1	G. E.	275
½	E. N. T.	2400
½	Spr.	1450 (2)
½	G. E.	1350 (2)
½	G. E.	1140
½	Emer.	850
½	R. & M.	3500
¼		1750 (8)
¼	G. E.	1650

LOW VOLT. GEN.

KW	Make	Volt
3	Wotton	93
4	Hertner	90
1½	Line.	88
8.4	G. E.	70
2	Roth	70
5	Imperial	70
1¾	G. E.	65
1½	G. E.	60
5	Hohlberg	55
5½	G. E.	50
4	Hohlberg	40
94	G. E.	60
48	West.	60
48	West.	30
9/10	H-C	25
10	West.	25
2	G. E.	16
1	West.	15
1	G. E.	12½
3/10	Ideal	12
1/2	H-C	10
1/8	Eager	7½
1-1/8	Roth	7½
5.1/2	Cr. Wh	7
1	H. V. W.	6

375/3000 V. DC. GEN.

KW	Make	Voltage
200	West.	600
60	G. E.	600
40	G. E.	1000
30	El. Dy.	600
20	G. E.	600
12½	West.	375
10½	G. E.	1500
5½	Eck	1500
5	G. E.	500
4	G. E.	400
3	Cont.	2000
2½	G. E.	3000
2½	G. E.	1600
2	G. E.	400
2	Burke	2000
1	G. E.	1000
1	El. Sp.	1000
1	G. E.	500

3—Latest Type 40 Kw. Reliance 230 V. D. C. Motor Generator Sets.

250 V. DC. GEN.

KW	Make	Speed
100	West.	900
45	West.	700
25	G. E.	1750
15	West.	1750
15	G. E.	1200
4	El. Dy.	1400
1½	Al. Ch.	1750
1½	Bogue	850
1¼	Diehl	2100
¾	Watson	1500
½	G. E.	1800
¼	Roth	1200

LOW VOLT. MOTORS

1/4 West. 32 V
3/4 Roth 32 V.
1½ G. E. 70 V.
1.9 G. E. 75 V

A. C. GENERATORS

KW	Make	Speed
200	G. E.	600
150	G. E.	720
100	West.	600
50	G. E.	1200
18	G. E.	1800

BUFFERS

5 H. P. B & D 230 volts D. C.

125 V. DC. GEN.

KW	Make	Speed
125	G. E.	2400
40	Cr. Wh.	1800
40	West.	690
35	G E.	1750
35	West.	1750
35	G. E.	1500
30	West.	1750
25	West.	1800
25	G. E.	1100
21	G. E.	1500
20	G. E.	650
18	Conn.	925
15	West.	1750
15	Cr. Wh.	1150
13.8	West.	1400
15	Roth	900
15	West.	1125
13	G. E.	690
12½	West.	875
12	G. E.	1800
10	G. E.	1450
9	El. Mchy.	790
7½	Ideal	1800
7½	West.	1450
6	G. E.	1750
5	G. E.	900
2.6	Cr. Wh.	3600
1½	G. E.	1200
1	Diehl	1000
½	G. E.	1800

WELDERS

Size	Make	Drive
400 amp.	West.	D. C.
300 amp.	Wilson	D. C.

HOISTS

Size	Hoist	Drive
5 ton	P. & H.	A. C.
2 ton	Link-Belt	D. C.
2 ton	G. E.	D. C.
1½ ton	G. E.	A. C.
1 ton	Shepherd	D. C.
1 ton	Yale	A. C.
½ ton	American	

AIR COMPRESSORS

12½x12 American
3½x6 Worthington

BLOWERS

Size	Make	Press.
3000	CFM I-R.	1½ lb.
3200	CFM I-R.	1 lb.
2 #16	Roto Clones	Type W
1 #12	Roto Clone	Type W
3—12x17	Needham	Rotary

BALANCING SETS

2—15 KW Star
1—65 amp. G. E.

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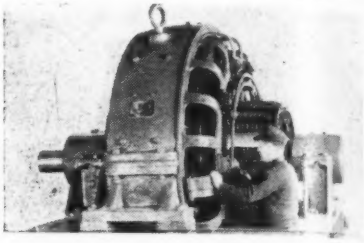

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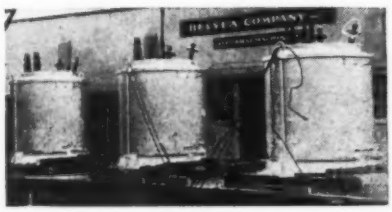

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1000 KW G.E., 250 V. D.C. to 1400 H.P. 11000/2300 V.

1—500 KW 3 unit consisting of 2—250 KW G.E., 250 V., d.c., to 1—700 HP, 2300 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 2200 V.

1—500 KW G.E., 250 V. D.C. to 1000 KVA. 2300 V. Syn. Motor.

1—400 KW G.E., 250/275 V., D.C. to 600 HP, 2300 V.

1—100 KW WHSE., 250 V. D.C. to 159 KVA. 2300 V.

1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.

2—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

1—40 KW WHSE., 230 V. D.C. to 45 KVA 2300 V.

1—35 KW A. B. See 230 volt D.C. to 50 H.P. 220 volt sq. cg. motor with exciter.

1—15 KW Cont. 230 volt D.C. to 25 H.P. 220 volt sq. cg. motor.

1—10 KW Balancing Set Gen. Elec. with 2—5 KW —125 volt generators.

TURBO GENERATOR SETS

1—500 KW Whse. 625 Kva. 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.

1—75 KW Ridgeway 250 V. D. C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM.

A. C. GENERATORS AND SYNO. MOTORS

3 Phase—60 Cycle

HP or KVA	Make	Type	Volts	Speed
1—1000	Whse.		2300	900
1— 625	Whse.		480	900
1— 500	G.E.	TS	440	360
1— 250	G.E.	ATB	2300	600
1— 250	G.F.	ATI	220	450
1— 225	G.E.	ATB	220	600
1— 150	Whse.		2400	900
1— 150	Whse.		4000	1800
1— 100	Whse.		2400	900
2— 100	Whse.		2300	1800

A. C. MOTORS

3 Phase—60 Cycle

SLIP RING

HP	Make	Type	Volts	Speed
2—1200	Cr. Wh.	801Q	2300	237
1— 800	Al. Ch.	ANY	440	885
1— 800	Whse.	CW	440	357
1— 600	G.E.	IM	440	900
1— 450	Whse.	HW	2200	875
1— 400	Al. Ch.	ANY	440	1200
1— 400	G.E.	MT	550/440	300
1— 400	Al. Ch.	ANY	2300	505
1— 350	G.E.	MT-442	2300/4000	257
1— 300	G.E.	IM	440	720
1— 300	Whse.	CW	440	585
1— 250	G.E.	MT	4000/2300	257
2— 200	G.E.	IE-M	2200	1750
1— 200	Whse.	CW	2200	514
1— 200	G.E.	I-M	440	600
1— 150	G.E.	IM	2200	695
1— 150	G.E.	MT-564	440	600
1— 150	G.E.	IM-17B	2200	290

SLIP RING MOTORS

H.P.	Make	Type	Volts	Speed
1— 100	G.E.	IM	220	1750

A. C. MOTORS

SQUIRREL CAGE

H.P.	Make	Type	Volts	Speed
1—500	G.E.	I-17B	2200	690
1—400	Whse.	CS-1104A	2200	585
1—300	Whse.	CS	550	580
1—300	G.E.	IK	440/2300	600
1—200	Whse.	CS	2300	1200
1—200	G.E.	IK	2200	490
4— 175	G.E.	IK	440	900
1— 150	Lincoln		440	1200
1— 150	G.E.	IE	440	1200
1—150	Al. Ch.	AN	440	1765
1—100	Whse.	CS	550	1750

GEAR REDUCTION UNITS

1—2100 H.P. Whse. 1800/360 RPM.

1— 943 H.P. G.E. 5306/1200 RPM.

1— 750 H.P. Al. Ch. 3600/600 RPM.

1— 450 H.P. G.E. 3600/1200 RPM.

THE BELYEA REPUTATION PROTECTS YOU!

ROTARY CONVERTERS

3 Phase—60 Cycle

1—1500 KW Whse., 720 RPM., D.C. 600 V. A.C. 11500 V.

1—1500 KW Whse., 600 RPM., D.C. 600 V. A.C. 11500 V.

1—1250 KW G.E., HCC, 720 RPM., D.C. 250 V. A.C. 2300 V.

1—1000 KW Whse., 900 RPM., D.C. 600 V. A.C. 11000/2300 V.

2—750 KW Whse., 1200 RPM., D.C. 600 V. A.C. 5500/2300 V.

1—750 KW Whse., 900 RPM., D.C. 600 V. A.C. 6600/2200 V.

1—500 KW Whse., 900 RPM., D.C. 250 V. A.C. 2300 V.

1—500 KW Whse., 1200 RPM., D.C. 600 V. A.C. 2300 V.

2—375 KW Whse., 1200 RPM., D.C. 250 V. A.C. 2300 V.

Rotary Converters

3 Phase 25 Cycles—Booster Type

2—1500 KW G.E., HCC, 500 RPM., D.C. 225/275 V., 6000 Amp., A.C. 13200/6600 V.

1—500 KW G.E., HCC, 750 RPM., D.C. 225/275 V., 2000 Amp., A.C. 6600 V.

TRANSFORMERS

60 Cycle

KVA	Make	Ph.	Type	Voltages
6—1667	Pitts	1	OISC	13200x2300
4— 525	G.E.	1	HJ-DD	2300x445
3— 400	Whse.	1	S	2400x440
2— 333	Whse.	1	OISC	2300x460
2— 333	Pitts.	1	OISC	2400x220
3— 300	G.E.	1	H	13200x2300/57
2— 200	G.E.	1	HILD	26400x115/46
3— 200	G.E.	1	H-KDD	13800x220/44
3— 150	Whse.	1	SK	2200x440/22
3— 150	Whse.	1	SKM	2400x120/24
6— 100	Whse.	1	SK	6900x460/23
3— 100	Whse.	1	OISC	13200x250

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1250	G.E.	MCF	250	650
2—1250	G.E.	MPC	500	130
1— 800	G.E.	MPC	550	600
2— 625	G.E.	MPC	250	130
2— 600	G.E.	MPC	550	600/800
1— 350	G.E.	MPC	230	450
1— 300	G.E.	MCF	230	400/100
2— 300	G.E.	DMC	230	400/600
1— 300	Cr. Wh.	CMC 102H	230	1150
2— 300	Whse.		500	250/400
1— 300	G.E.	MPC	230	275/550
1— 300	G.E.	MPC	230	250/440
1— 250	Al. Ch.	Irt	230	525
2— 200	Whse.		230	400/500
1— 175	Whse.	SK	250	150/525
2— 150	G.E.	RC-19	230	800/1000
1— 150	Cr. Wh.	CCM	230	300/1050
1— 150	Whse.	SK	230	300/900
2— 125	G.E.	CO-1832	230	625
2— 120	Whse.	SK	230	720
1— 100	Al. Ch.		230	950/1150
3— 100	G.E.	LC	230	1200
1— 100	G.E.	MPC	230	225/450
1— 100	Whse.	SK	230	600
2— 100	G.E.	RC-19	230	575/720
1— 75	G.E.	C	230	500/100
3— 70	Whse.	SK-183	230	560/780
4— 60	Diehl	K-11	230	500/1000
2— 60	Cr. Wh.	CMC-65H	230	500/1000
1— 50	Cr. Wh.	CMC-81H	230	300/900
1— 50	Cr. Wh.	CMC-80H	230	380/750
1— 50	G.E.	RC	230	400/1200

RE-NU-BILT BELYEA MOTORS

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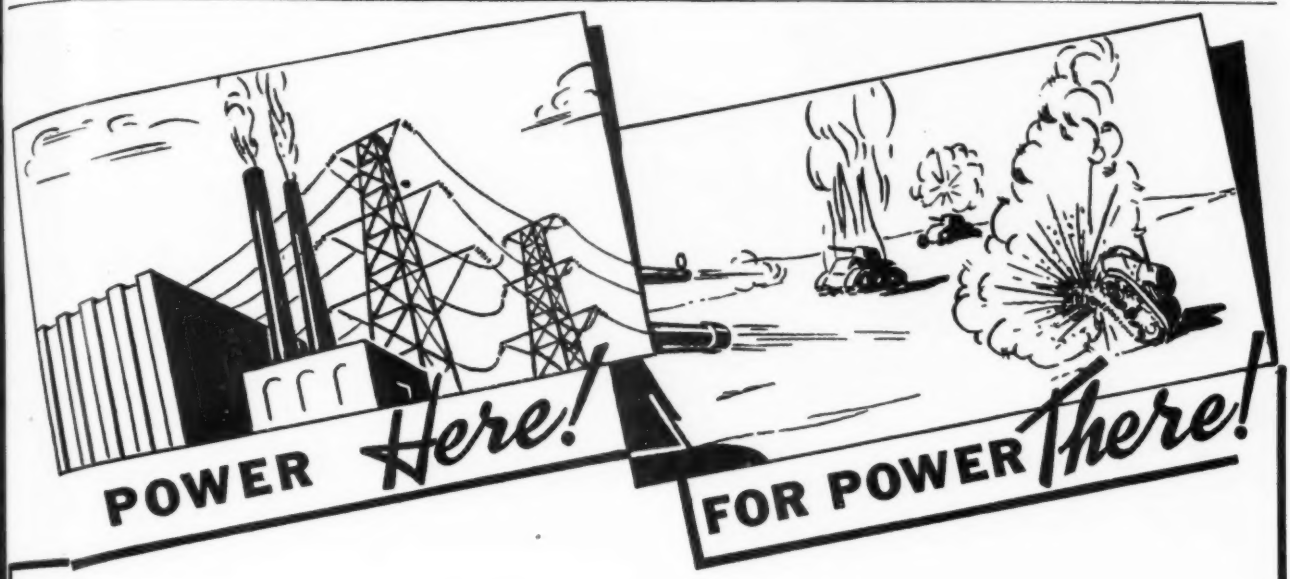
COMPANY INC.

Main Office & Shop: 43 HOWELL ST., JERSEY CITY, N. J.



MOTORS GENERATOR SETS

1—2000 ampere, 6 volt, Hanson-Van Winkle
1—1500 ampere, 6 volt, Hanson-Van Winkle
1—750 KW, 250 volt, Allis Chalmers synchronous
1—75 KW, 125 volt, Crocker-Wheeler synchronous
1—35 KW, 125 volt, Electric Machinery squirrel cage induction motor.
1—20 KW, 600 volt, General Electric squirrel cage induction motor.

ALTERNATORS

1—526 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volts, Allis Chal.

MOTORS—3 PHASE 60 CYCLE

1—400 HP, 514 RPM, 440 volt, Westg., slip ring.
1—325 HP, 600 RPM, 2300 volt, G.E., syn.
1—300 HP, 720 RPM, 2200 volt, G.E., slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., Sync.
1—200 HP, 600 RPM, 2200 volt, G. E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, General Electric, squirrel cage.
1—150 HP, 900 RPM, 440 volt, Al. Ch. sl. rg.
1—150 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—150 HP, 600 RPM, 440 volt, G.E. sl. rg.
1—150 HP, 400 RPM, 440 volt, G.E. sq. cg.
2—125 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 900 RPM, 440 West., sq. cg.
1—100 HP, 900 RPM, 440 volt, G.E., sl. rg.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.

INSTRUMENTS

25—Westinghouse type U Recording Ammeters with slit core, CT.

25—Westinghouse type U Recording Voltmeters.

MOTORS—3 PHASE 60 CYCLE (Con't)

2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, 400 RPM, 550 volt, Cr. Whlr., sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, G.E., sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—75 HP, 720 RPM, 440 volt, G.E., sq. cg.
2—75 HP, 1200 RPM, 2200 volt, G.E., Vertical.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL, Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westghse., 550 RPM, Type SK.
1—150 HP, 750 RPM, Elecrto Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 300 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-12, Form A.
2—20 HP, Westghse., 1700 RPM, Type SK.
1—15 HP, G.E., 800 RPM, Type RC-11.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—250 KVA, G.E., 6600/2200/220/440.
3—200 KVA, G.E., 2300/220/440.
3—150 KVA, G.E., 33,000 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200 250 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
3—50 KVA, Wagner, 4150-220 volts.
2—50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
4—37½ KVA, 2200-220/110 v.
7—25 KVA, Westg., air cooled, 440/220-110 volts.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

1—150 HP, 350/1050 RPM, Crocker-Wheeler
2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—200 KW, G.E. 3 ph., 60 cy., 220 v., cond.

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J. L. HEMPHILL & COMPANY

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CONTROLS
TRANSFORMERS
MOTOR GENERATOR SETS
ETC.

BERGER OF ROCHESTER, N.Y.

Put all idle equipment to work. Send your list for prompt action.

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300, 1 phase 25 cycle.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
1—200 KVA Allis Chal. 60 cy. 3 ph., 220/440.

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KW, West. Unity Power Factor, 3 PH. 60 cyc. 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V, 600 RPM.
50 KW Milwaukee, Comp. Wound 125 V, 600 RPM.

MOTOR GENERATOR SET

Western Elect. 1000 Amps—40 Volts direct con. to either on AC or DC 580 RPM Motor.

CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
35 H.P.—G. E. Form D—550 Volts—590 RPM
25 H.P.—G. E. Form E—550 Volts—760 RPM

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle, 750 speed, 220/230 volts. With Transformers for 2300 volts.

FREQUENCY CHANGERS

40 KW GE type I.T.T. frame 553 3 ph. 25/62, ⅓ cy. 220 volts primary 440 volts secondary, 750 RPM direct con. to 40 H.P. GE type KT543—3 ph. 25 cy. 220 volt 750 RPM.

OTHERS IN ALL SIZES VOLTAGES AND CYCLES

3 ph. 60 cy. A. C. MOTORS

H.P.	Make		Type	Speed	Volts
300	Gen. Elec.	Sl. Rg.	1 Form M.	600	220/440
200	West	Syn.	.08 P. F.	900	220/440
200	Gen. Elec.	SR	1. M	900	2300
200	Wsghse.	Sl. Rg.	CW	600	220/440
200	Gen. Elec.	Sq. Cg.	1 Form K	514	220/440
175	Ideal	Sl. Rg.	AVA	1750	2200
150	Gen. Elec.	Sq. Cg.	I K	600	2300
150	Al Ch.	Sq. C.		600	440
150	Burke	Sq. Cg.	3 BRG. 2 ph	900	220/440
125	Gen. Elec.	SR	MT. 553	1200	220
125	Gen. Elec.	Sq. Cg.	I K	720	220/440

3 ph. 25 cy. MOTORS

H.P.	Make		Type	Speed	Volts
830	Elect. Mach.		Syn. With Direct Connected Exciter	500	2300
150	Burke		Syn. With Direct Connected Exciter	500	440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
100	Gen. Elec.	Sl. Rg.	I Form M	750	220/440
100	Gen. Elec.	Sq. C.	I K	750	220/440
100	Wsghse.	Sq. C.	CS	500	220/440
75	Wsghse.	Sq. C.	CCL	500	220/440
75	Gen. Elec.	Sl. Rg.	I M	750	220/440
75	Wagner	Sq. C.	BM	750	2200
75	Gen. Elec.	Var.	BTA	375/750	440
50	Burke	Syn.	AC133	750	220

230V D. C. MOTORS

H.P.	Make	Type	Speed
100	Northwestern	K30 Comp. Inter.	1750
100	Wsghse.	SK143 Shunt Inter.	1750
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	1700
67	Otis	Elevator Motor-Comp. wd.	1200
60	Sprague	D—Comp. Wound	625
50	Gen. Elec.	C. L. 6 Shunt Wound	560
50	West.	SK120	1700
40	Fair. Morse	Ball BRG. Vert. Comp.	1740
32	Sturdevant	C Form P. Shunt Wound	190

Only partial listing

OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.

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THE FRED W. KIEMLE CO.
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TOLEDO OHIO

Now Is the Time to Throw Everything We Have at the Enemy and Save Hundreds of Thousands of American Boys

TURBOS—60 cycles

15000 KW capacity condensing, non-automatic bleeder (approved 275# 550° t.t.) volume extraction at either 100 or 65# g.b.p. Elspecs 60/3/standard voltage. Complete going unit including surface condenser, all auxiliaries and piping.

•

3—5000 KW 80% nominal, 7200 KVA range, 225# I.S.P. Elspecs 60/3/2300/3600. High percentage original full strength, otherwise necessary blading in stock.

2—3125 KVA Multi-Stage Condensing 60/3/2300/3600. One complete with surface condenser lay out and all standard auxiliaries for complete installation; One now with jet condenser, but liberal capacity surface condenser available from other stores.

3—2000 KW 80% nominal, 2500 KW approved range 60 3/1440, 2-2300, condensing design and approved for non-condensing.

•

Several 300, 500, 750, 1000, 1200 and 1500 KW condensing standard pressure, also mixed pressure design.

•

TURBOS—25 cycles

50,000 KW total aggregate capacity, unit sizes of 3,000, 6,000 to 20,000 KW surface condenser equipped complete going units. High percentage full strength.

SURFACE CONDENSERS

8250, 11000, 12000, 15000 and 20000 sq. ft. surface condenser units complete. Log service on pure clear water. Condition sound.

WATER TUBE BOILERS

2—350# ASME 80,000/120,000# t.s.g. cross drum units, underfeed stoker equipped.

WATER TUBE BOILERS (Con't)

4—1000 HP Steel Header Longitudinal Drum Type Water Tube Boilers 250# ASME Code design, and verified in recent inspection for re-erection. Now oil fired.
A complete going boiler station including modernly designed self-supported steel structure, and all standard boiler plant auxiliaries, piping, etc.
Approximately 2½ to 3 years each total log hours service.

•

3—700 HP 160,000# t.s.g. straight tube box steel header 200# ASME, without firing equipment.

•

8—400 HP 200# ASME bent tube design, superheaters, soot blowers, fans, heaters, coal and ash handling paraphernalia, etc. Also complete steel building.

•

8—650 HP Babcock Wilcox sectional header straight tube 3 longitudinal drum type 200# approved water tube boilers, superheater and type E heavy duty stoker equipped.

•

12—200/500 HP straight and bent tube 200# units.

STOKERS

5 type E heavy duty combustion engineering company stokers.

•

30 combustion engineering company multiple retort stokers.

LARGE POWER TRANSFORMERS

50,000 KVA O.I.W.C. transformers 150,000/135,000 delta—41,600/36,400; or 72,000/63,000 star.

9000 KVA transformers, as above.

15,000 KVA O.I.W.C. 60,000/54,000—18,000/9000.

12,000 KVA O.I.W.C. transformers, 16,000 through 12,000, 500 and 250 KVA unit sizes, 75,000/43,000—2300 and other standard voltage ratios.

Complete data available on request.

"LOYAL COOPERATION IN HEAVY POWER MOVEMENT THRU 3 WARS"

"Now in World War II—May We Confirm Intent and Ability, Face to Face?" . . . P.S.

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If you ever have any worries about buying rebuilt used machinery, you can end them by looking for the O'Brien nameplate, This nameplate is your assurance that the machinery or power plant equipment was carefully selected before we purchased it; that it was dismantled, thoroughly cleaned with high pressure steam and worn parts were repaired or replaced. After assembly, it was tested under power, inspected and pronounced O. K. before shipment. To be sure it's good, be sure it's O'Brien.

BACK THE ATTACK —WITH WAR BONDS

MOTOR GENERATOR SETS

1000 K.W. G.E., 3 unit, 135/270 V, 1400 H.P., Synchronous 3/60/2300/514 RPM
750 K.W. G.E., 4 unit, 240/240/240/1200 RPM, 1200 HP Synchronous 3/60/2300
500 K.W. G.E. MPC, 250 V, 700 KVA, 3/60/2300
250 K.W. G.E. MPC, 240 V, 1200 RPM, 3/60/2300
150 K.W. Ridgway 250 V, 3/60/2300/900 RPM
125 K.W. G.E. 250 V. 900 R.P.M. Syn. 3/60/2300.
100 K.W. G.E. Syn. Drive 250 V, 3/60/220/1200
100 K.W. West. 125 V, 3/60/2300 Sq. Cg.
75 K.W. G.E. Sq. Cg. 250 V, 3/60/2300
50 K.W. G.E. RC Syn. Drive 125 V, 3/60/220/1200 RPM
50 KVA G.E. 3/60/220 75 H.P. Drive 125 V.
50 K.W. West. 150 V, Syn. Drive 3/60/220
50 K.W. G.E. 125 V, Sq. Cg. 3/60/2300/720 RPM
35 K.W. Fairbanks-Morse 240 V, Syn. Dr. 3/60/220
10 K.W. Crocker Wheeler Balancer 125 V
5 K.W. G.E. 125 V, 3/60/220/1800 RPM.

STEAM ENGINE GENERATOR SETS

Alternating Current

1000 KVA West.—Skinner Uniflow 3/60/440
750 KVA G.E.—Skinner Uniflow 3/60/2300
625 KVA G.E.—Cooper Corliss 3/60/240.
400 KVA Allis-Chalmers Corliss 3/60/480
375 KVA West.—Skinner Uniflow 3/60/440
325 KVA G.E.—Chuse Uniflow 3/60/220/2300
300 KVA G.E.—Ames Uniflow 3/60/480
210 KVA G.E.—Skinner Uniflow 3/60/480
500 K.V.A. G.E.—Ames Uniflow 3/60/240.
125 KVA G.E.—Chuse 4 valve 3/60/240
50 KVA West.—Harrisburg Automatic 3/60/220/2300

STEAM TURBINE GENERATOR SETS

Condensing—A.C.

1—4000 KVA Allis Chalmers 3/60/2300/3600 RPM
1—3125 KVA Gen. Elec. 3/60/2300/3600 RPM
1—1560 K.V.A. Westinghouse Bleeder 3/60/480.
1—1500 KVA Westinghouse 3/60/2300/3600 RPM
1—1250 KVA Gen. Elec. 2/60/2300/3600 RPM
1—750 K.W. Allis Chalmers 3/60/480/3600.
1—625 K.W. Allis Chalmers 3/60/480/3600.
3—625 KVA Allis-Chalmers 3/60/2300/3600 RPM
1—625 KVA Gen. Elec. 2/60/2300/3600 RPM
1—500 KVA West. Geared, 3/60/2400/6000—900 RPM
3—500 KVA Gen. Elect. Bleeder 3/60/220/3600 RPM
1—250 KVA Worthington Moore Bleeder 3/60/220
1—187 KVA Westinghouse geared 3/60/2300
1—150 KVA Westinghouse 3/60/240/3600 RPM

Non-Condensing—A.C.

1—500 KVA West.-Moore 3/60/220 New 1931.
1—500 KVA G.E.—Terry 3/60/120/208/3600 RPM New
1—500 KVA Westinghouse geared 3/60/480 New
1—375 KVA Westinghouse geared 3/60/2300
1—375 KVA Allis Chalmers 3/60/240/3600 RPM
1—125 KVA Al. Ch.—Kerr 2/60/220/3600 RPM
1—75 KVA Allis-Chalmers 3/60/240/3600 RPM

A. S. M. E. BOILERS

2—686 H.P. Sectional Header 3 Drum Straight tube 200 lb. Non Condensing.
1—500 H.P. Keeler-Wetzel Stoker, 160 lbs.
1—400 H.P. Wickes 200 lb. New 1931 with Stoker.
1—400 H.P. Babcock Wilcox W.T. 200 lb. W.P.
2—300 H.P. Edgemoor 160 lb. Taylor Stokers New 1931
2—250 H.P. Union Water Tube—Taylor Stokers
2—250 H.P. International self-contained, 200 lbs.
1—200 L.P. Coatesville H.R.T. 150 lbs.
3—200 H.P. Heine 150 lb. Non Condensing
1—100 H.P. Babcock & Wilcox W.T. 350 lb. W.P.
2—100 H. P. Erie H.R.T. 100 lb. with Stokers.

Everything from a Pulley to a Power House

THE O'BRIEN MACHINERY CO.

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

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REBUILT POWER EQUIPMENT

READY TO SHIP!

ROTARY CONVERTERS

1—200 kw. G.E. 275 v. 900 rpm., 6 ph. 60 cy. complete with overspeed device and transformers.

1—500 kw. G.E. type HC-8 600 volt, 900 rpm., 6 ph., 60 cy. pedestal bearing with overspeed device complete with transformers.

MOTOR GENERATOR SETS

500 kw. G.E. 250 v. D.C. 1200 rpm., 2300 c. 3 ph. Syn. Motor.

150 KW Ridgway 250 v. DC, 900 rpm. dir. con. 2300/3/60 syn. motor, complete.

1—150 kw. Crocker Wheeler 250 v. DC, 600 rpm. dir. con. to 220/440 or 2200 v. syn. motor.

125 kw. Cr. Wh. 250 v. D.C. 1200 rpm., 220/440 v. 3 ph. 60 cy. Ind.

ENGINE GENERATOR SETS

225 kw. Elec. Machy 2200 or 220 v. 2 ph. 60 cy. dir. con. Ideal Steam.

1—225 kw. Elec. Machy. 2200/220 or 440 v. 3 ph. 60 cy., 200 rpm. dir. con. Ideal Engine 4 valve non-releasing.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)

1—150 kva. Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.

1—250 KW 480 V., 3/60, Allis-Chalmers, 150 rpm.

A.C. MOTORS—3 ph. 60 cy.

Qu	HP	Make	Volts	Speed	Type
18	½	G. E.	220	900	K
33	½	G. E.	220	1140	K
19	1½	Ilg. (Totally enclosed)	220	490	ball bearing
1	10	Allis Chal.	220	1200	
1	10	American (Enclosed ball bearing)	440	570	PK
3	10	G. E.	440	570	KT-322
11	10	G. E.	440	495	KT-332
9	15	Allis Chal.	440	1500	AN
1	15	Burke	220	1200	EM 1.2
1	15	Triumph	220	1150	
1	15	G. E.	440	900	I-K
1	15	G. E.	440	900	KT-322
2	15/30	West. (Two speed induction Motor)	220	550/1100	MS
1	15	Allis Chal.	440	860	ball bearing
1	15	G. E.	440	865	
2	15	Triumph	440	850	ball bearing
3	15	G. E.	440	690	KT
3	15	G. E.	440	575	KT-326
8	15	G. E.	220	570	KT-332
2	15	West.	220	550	MS
1	15	West.	440	450	CS
1	15/45	West.	440	450/850	CS
9	20	Allis Chal.	440	1800	AN
1	20	West.	220	1750	
1	20	Reliance	440	1200	
1	20	G. E.	440	1200	KT
1	20	G. E.	440	875	
1	20	Triumph (High torque)	220	900	TR 10-S
1	20	G. E.	220	900	
1	20	Allis Chal.	440	720	
9	20	G. E.	440	690	KT-332
1	20	West.	440	680	
2	25	West.	220	720	CS
1	30	G. E.	440	1200	KT-332
2	30	West.	220	1100	MS
1	30	Al. Ch.	220	900	
1	30	Allis Chal.	220	900	NR

A.C. MOTORS—3 ph. 60 cy.—con't

NO.	HP	Make	Volts	RPM	Type
1	30	Triumph	220	525	TR-138
1	35	G. E.	440	1200	I
1	35	Lincoln	220	720	
2	35	West.	220	514	CS
	30/36	G. E.	220	3600	KT-205y
1	35	Cr. Wh.	220	570	122Q
1	40	Allis Chal.	220	900	
1	40	G. E.	220	720	KT-346
1	40	Am. Elec. (Vertical ball bearing)	440	685	
2	40	Am. Elec. (Enclosed ball bearing)	440	685	PK
1	40	West.	220	600	CS
1	45	West.	440	850	CS
7	50	Allis Chal.	440	1800	AN
2	50	West.	440	1800	C
1	50	Cr. Wh.	220	1160	
1	50	West.	440	1120	C
4	50	G. E.	220/440	900	
1	50	Am. vert.	220/440	900	
1	50	West. (enc.)	220	720	CS
1	50	West.	220	720	CS
1	50	West.	220/440	690	C
1	50	West.	220/440	650	CCL
1	50	West.	220	600	CS
1	50	West.	220/440	514	CS
1	50	G. E.	220/440	450	I-K
1	50	G. E.	220/440	400	I-K
1	50	West.	220/440	1200	MS
1	50/100	West.	400	345/700	
1	54	Al. Ch.	220/440	900	AN
1	60	Wagner	220/440	1200	
3	60	Al. Ch.	220/440	1800	
2	60	Al. Ch.	220/440	1200	
1	60	West.	220/440	900	
2	60	West.	220	720	CS
2	60	G. E.	550	600	I
2	60	Triumph	220/440	430	
3	65	Al. Ch.	220/440	1800	
3	75	Al. Ch.	220/440	1800	
1	75	West.	440	1200	MS
1	75	G. E.	220/440	1150	I
1	75	U. S. (drip proof)	220/440	900	
1	75	G. E.	220	900	
2	75	G. E.	550	720	I
1	75	West.	220	600	CS
1	100	West.	220	1750	
1	100	U. S. (drip proof)	220/440	1160	
2	100	G. E.	550	900	
1	100	West.	220	720	CS
1	100	Cr. Wh.	220	575	
1	100	G. E.	440	400	I-K
1	125	G.E.	220/440	1800	I
1	125	Cr. Wh.	220	720	QB
1	125	G. E.	220/440	514	I-K
1	125	G. E.	220/440	450	I-K
1	125	G. E.	220	400	I-K
1	150	Wagner	220/440	1800	
1	150	West.	2200	720	CS
2	150	G. E.	220/440	600	I-K
2	150	G. E.	220/440	514	I-K
1	150	G. E.	220	450	I-K
2	200	West.	220/440	900	CS
1	200	G. E.	220/440	720	I-K
1	200	West.	220/440	720	CS
1	200	G. E.	220	600	I-K
1	200	West.	220/4	580	CS
1	200	G. E.	220	514	I-K
1	225	G. E.	2200/440/220	200	syn.
1	250	G. E.	220/440	1200	KT
2	250	West.	220/440	1200	
1	250	G. E.	220/440	720	I-K
1	260	West.	2200	450	syn.
1	300	West.	440	1200	CS
1	400	West.	2200/220/440	500	CS
1	800	G. E. vert.	6600	1200	KJ
1	1000	G. E.	2300	500	K

SLIPRING MOTORS—3 ph. 60 cy.

NO.	HP	Make	Type	Volts	RPM
1	1500	West.	CW	2200	435
1	700	G. E.	MT-432	2200	393
1	400	West.	CW	440/220	1170
1	300	West.	CW-1106	2200	580
1	300	W. El.	1-12	440/220	600
1	250	West.	CW	2200	345
1	100	G. E.	I	220	450
1	100	West.	CI	220/440	1750
1	75	Cr. Wh.		220/440	875
1	60	Triumps	C-16	220/440	430
1	60	West.	HF	2200	690
1	53	G. E.	I	220/550	1165

TRANSFORMERS—1 ph. 60 cy.

NO.	Kva.	Pri.	Sec.	Make	Ph.
1	250	2300	460	G. E.	
1	150	2200	230/460	G. E.	3 ph.
1	100	2200	110/220	G. E.	
3	100	6600	550/440/220	Pgh.	
2	75	2200	220	Burke	3 ph.
2	50	2300	220/440	G. E.	
3	50	11430/6600	550	Al. Ch.	
3	50	6600	575	G. E.	
1	37½	2300	220/440	Wagner	
3	37	4400	185	West. (Rotary)	
1	30	2200	110/220	G. E.	
2	30	440	220/110	West.	
25	25	2200	110/220	G. E.	
3	15	2200	110/220	G. E.	
35	10	2200	110/220	G. E.	
40	10	2200	110/220	West.	
100	7½	2200	110/220	G. E.	
50	7½	2200	110/220	West.	
50	5	2200	110/220	G. E.	
75	5	2200	110/220	West.	

VARIABLE SPEED MOTORS—230 V. D.C.

No.	Hp.	Make	Type	RPM
1	35	West.	sk-140	675/1350
1	30	West.	sk-123	850/1700
1	30	G. E.	RLC	450/900
4	20	West.	sk-100L	750/1500
2	10	G. E.	le	625/1250
1	5	G. E.	CD-85	450/1800
2	3	Jantz Liest	BI	650/1950
3	2½	G. E.		500/1000
1	2	West.	SK-63	300/1800
1	2	West.	SK-23	700/2100
1	½	Northern		700/2100

25 MOTORS 220/440 V. A.C.

Qu	HP	Make	Type	RPM
1	75	G. E.	I-4	900
1	75	Allis-Chalmers	AN	900
6	40	Allis-Chalmers	AN	900
1	35	Western Elec.	SL13B	500
1	35	West.	M	900
1	30	West.	C	720
7	30	Allis-Chalmers	AN	900
2	25	West.	MS	715
9	10	Allis-Chalmers	AN	900

DIESEL ENGINE GENERATOR SET

217 KVA, G.E. 2300/3/60 dir. con. 260 HP Buckeye 2 cyl. 200 rpm. semi-diesel engine complete.

AIR COMPRESSORS

2—677 cu. ft. Nat'l. Brake & Elec. type Q3VD, 2 stage, 100# pres., dir. con. to 150 HP, Westg. Syn. Motors, 2300 v., 3 ph., 60 cy., 900 rpm., 80% P.F. with 5.25 kw. Westg. type SK Exciters 900 rpm.; also Bowser Oil Pumps and Nat'l Brake Governors.

INDUSTRIAL TRUCKS

1—Elwell Parker Tow Tractor 2000 lb. with batteries.

1—Baker Tow Truck with batteries.

PUMPS

1—2" gasoline driven portable Sterling Machy. Co.

CRANE

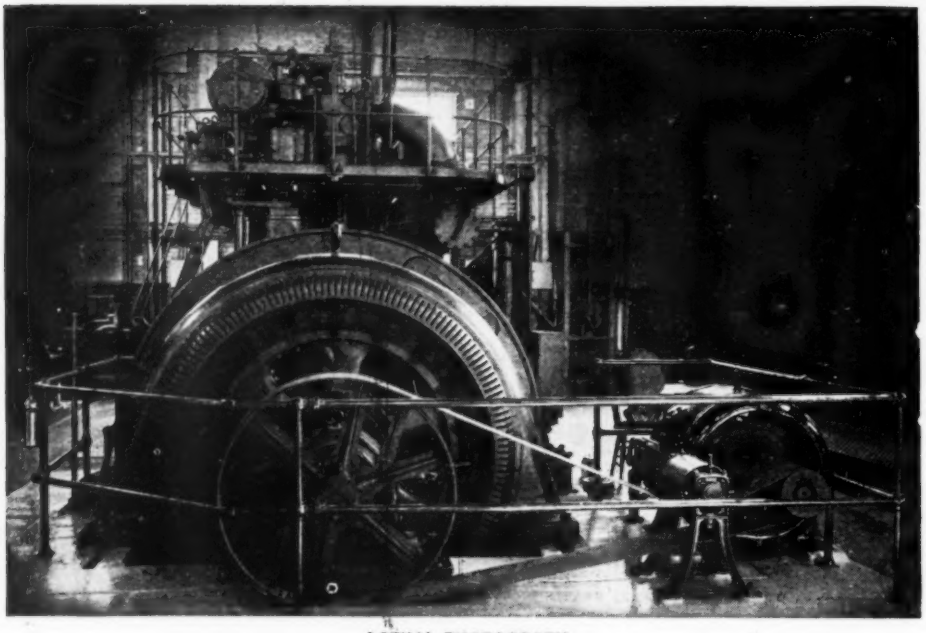
1—20 ton Whiting Crane 36'10" span motor driven lift, hand power.

WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS

DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH 6, PA.

450 KVA DIESEL ENGINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

AVAILABLE IMMEDIATE DELIVERY

450 KVA General Electric; 2 or 3 phase, 60 cycle, 2300/550/440 volts, 200 RPM alternating current generator direct connected to Busch-Sulzer vertical full Diesel engine complete with auxiliaries. A#1 operative condition—still on original foundation for operating test.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

7500 KVA Westinghouse condensing 200 lb. pressure, 2300 volts, 1800 RPM complete with either surface or jet condenser.

6250 KVA Westinghouse condensing 175-200 lb. pressure, 2300 volts, complete with surface condenser.

3125 KVA—2500 KW 80% P.F., G.E. 2300 volts, 3600 RPM, 180-200 lbs. pressure, 500 degree total temperature, equipped with surface condenser, condensing auxiliaries, panels and instruments. A complete installation.

1875 KVA G.E. condensing 175-200 lb. pressure, 500° T.T., 6600 volts, 3600 RPM complete with condenser.

937 KVA Allis condensing 150-200 lb. pressure, 475° T.T., 2300 volts, 3600 RPM complete with direct connected exciter, surface condenser and auxiliaries.

625 KVA G.E. condensing 200 lb. pressure, 2300 volts, 3600 RPM complete with condenser and auxiliaries.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) G.E. non-condensing, 150-175 lb. pressure, 5 lb. back pressure, 2300 volts, 3600 RPM each complete with direct connected exciter.

125 KVA G.E. non-condensing, 110-125 lb. pressure, 0-10 lb. back pressure, 240 volts, 3600 RPM complete with switchboard.

ENGINE-GENERATOR UNITS

Direct Current

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. pressure, equipped surface condenser.

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to a 14" x 18", 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switchboard.

400 KW G.E. 125 volts, 165 RPM generator direct connected to a 26" x 28" Elliott Ridgway Unaflow non-condensing engine.

300 KW Westinghouse, 250 volts, 175 RPM generator direct connected to a 24" x 26" Skinner Unaflow non-condensing engine.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

750 KVA G.E. 2300/480 volts, 150 RPM generator direct connected Ames Unaflow non-condensing engine complete.

312 KVA Elliott 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westignhouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

MOTORS

—3 phase, 60 cycle

1500 HP Allis-Chalmers, 2,300 volts, 200 RPM slip ring.

250 HP (2) G.E. form M, 440 volts, 450 RPM three-bearing slip ring.

150 HP (5) G.E. form K, 2200 volts, 580 RPM squirrel cage.

125 HP 80% P.F. Elec. Mchy. 440 volts, 400 RPM synchronous.

50 HP G.E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

SPECIALS

2000 KVA G.E. 3 phase, 60 cycle, 480 volt, 300 RPM alternating current generator.

1200 KVA G.E. 3 phase, 60 cycle, 2400 volts, 300 RPM alternating current generator direct connected to a 1700 HP, 3 phase, 25 cycle, 2300 volt synchronous motor.

750 HP, 28" x 32" Skinner, 150 RPM Unaflow belted type engine, 125 to 155 lb. pressure at throttle, 20 to 30 lb. gauge back pressure.

SPECIALS

(Continued)

528 HP Heine A.S.M.E. code water tube boiler 350# pressure, 635°F., complete with stoker, superheaters—a complete installation—modern and practically new.

522 HP water tube boiler ASME code, 210 lb. pressure complete with stoker and accessories. New 1927.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

330 KW G.E. synchronous rotary converter 600 volt direct current—6 phase, 60 cycle alternating current—1200 RPM with 2300 to 408 volt transformers.

200 KVA Westinghouse 3 phase, 60 cycle, 240 volt, 200 RPM engine type generator.

1055 cu.ft. 100 lb. air pressure Chicago Pneumatic horizontal compressor direct connected to 170 HP, 240 volt, 150 RPM G.E. direct current motor.

SYNCHRONOUS CONDENSERS

1350 KVA Total Capacity

750 KVA and 600 KVA G.E. type ATI, 3 phase, 60 cycle, 240 volts, 900 RPM synchronous condensers each complete with direct connected exciter, switchboard panel with instruments. Are in A#1 operative condition—still on original foundation for operating test.

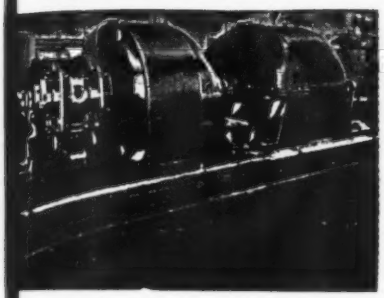
Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

"HEAT and POWER"

TURBO GENERATOR SETS



750 KW Ridgway, 1800 RPM turbine, mixed pressure 135# Gauge 15# Absolute with C. H. Wheeler 2 Pas. surface condenser, direct coupled to a 250 Volt DC Generator 750 KW 1800 RPM.

BOILERS

1—800 HP B & W Straight Tube Waste Heat Boilers, 200 lbs. pressure, complete with Economizers, motor driven induced draft fans, and steel stacks.

2—684 HP Edgemoor Waste Heat Boilers, 200 lbs. pressure complete with Economizers, Super Heaters, motor driven blowers and steel stacks.

1—400 HP. B & W Straight Water Tube, cross drum boilers. Sectional steel headers, 200 lbs. press., ASME code.

1—400 HP, B & W Straight Water Tube longitudinal drum boilers Sectional steel headers, 200 lbs. press., ASME code.

2—253 HP Heine Water Tuber Boilers, 160 lbs. pressure, ASME code.

All above completely rebuilt and guaranteed.

TRANSFORMERS

60 cycle, single phase

2—500 Kva Maloney 2300/230/115 oil cooled
3—100 Kva Pitts. 2400/240/120 oil cooled
4—5 Kva Weghse 2300/230/460 air cooled
3—5 Kva Gen. Elec. 460/230/115 air cooled
6—3 Kva Gen. Elec. 2300/230/115 air cooled

MOTORS

230 V. DIRECT CURRENT

Q	H.P.	Make	Type	R.P.M.
1	450	AL. CH.	INT.	425
1	150	G. E.	RC	1750
1	100	RELIANCE	1050 T	500
1	125	G. E.	DLC	550
1	100	WSGHSE	SA	250
1	75	WSGHSE	SK	1750
2	50	WSGHSE	SK160	565

3 PH. 60 CYCLE AC. 220/440 VOLT SQUIRREL CAGE

1	125	CR. WH.	125Q	900
1	100	GEN. ELEC.	IK	514
3	30	WAGNER	19VRM	720
1	50	WAGNER	22VRM	600
1	40	RELIANCE		900
2	20	RELIANCE	120AA	900
1	20	U. S.	B.B.	720
5	15	RELIANCE	C404	900
1	15	CENTURY	SCN19BB	1200

SLIP RING 440 Volt

1	150	WSGHSE 2200/550/440/220 volts	HF	495
2	150	Al. Ch.		600
1	30	GEN. ELEC. IM		900
1	25	GEN. ELEC. IM		900
1	15	GEN. ELEC. ITC		900

SYNCHRONOUS

1	268	GEN. ELEC.	2300	600
2	200	WSGHSE	2200 Volt	900
1	125	WSGHSE	2400	900
1	105	Electric Machinery	2200 Volt	1800
1	75	Gen. Elec.	220 Volt	900

Hundreds of other motors from 1 H.P. up

SPEED REDUCERS

4—15 H.P., W. A. Jones Spur Gear TE.
4—10 H.P., W. A. Jones Spur Gear TE.

PUMPS

2—Davidson 14 x 9¼ x 16 Simplex Double acting Piston pattern, brass fitted.
1—Warren 14 x 8½ x 12 Duplex brass fitted.
1—Blake 14 x 8½ x 10 Simplex.

GENERATORS

230 V. DC

45 KW Diehl K 18 550 RPM.
100 KW Ft. Wayne MPL 550 RPM.
100 KW GE MPL 600 RPM.
200 KW Sprague 525 RPM.
200 KW West. 500 RPM.
250 KW West. 500 RPM.

CONDENSER

1—C. H. Wheeler 3650 Sq. Ft. Surface Cond. 2 pass, complete with pumps.

STOKER

1—Jones, 3 retort, steam actuated, underfeed, ram stoker.

STEEL TANKS

400,000 gal. Steel Water Storage Tank. 40' high, 40' dia.

• TUBES

5000 CONDENSER TUBES

Condenser Tubes 1" OD 20 Gauge Admiralty 18 ft. long, like new.

BOILER TUBES
212 New Seamless

3½" 10 ga. boiler tubes 17'1" long.

Thousands Feet of Conduit ¾" to 3"

Write for Bulletin #P-100

PUMPS

Cameron Centrifugal

Purchased New 1923

Bronze fitted, mounted on common sub-base for motor drive—

1—Size 12—700 RPM 3020 GPM 45' head 60 HP
1—Size 14—700 RPM 4700 GPM 35' head 60 HP
1—Size 14—720 RPM 5500 GPM 30' head 75 HP
1—Size 16—850 RPM 8500 GPM 45' head 125 HP

All Pumps Tested Hydrostatically For 125#

All Double Suction Volute, Gate Valves Attached

(1) Steel Plate Barometric Condenser

Pumps Handled Fresh Water From Spray Ponds.

HEAT and POWER Company, Inc.

15 BOND STREET — Phone: ALgonquin 4-3874 — NEW YORK, 12, N. Y.

"GET IT FROM POWER"

EQUIPMENT COMPANY

SPECIAL

1—25 K.V.A. Diehl A.C. Gen. 240 V., 60 Cycle, 3 Phase, 1800 R.P.M., with Belted Exciter on Base direct connected to 38-Buick Engine, can be used by gasoline or natural gas, all complete. FOB Rochester.

We also have in stock all kinds of—

TRANSFORMERS
COMPENSATORS
OIL CIRCUIT BREAKERS

All types of—
SWITCHBOARD EQUIPMENT

Generator Sets—ALL— voltages and speeds.

Send full details of Unit desired. Will quote.

SPECIAL

1—200 HP, West., CW, Slip Ring
MOTOR
220 V, 60 Cyc., 3 Phase, 1200 RPM
also
1—35KW, MG SET
GE, 125 V, 1200 RPM, Direct connected to a 50 HP motor
IMMEDIATE SHIPMENT

MOTORS—SQ. CAGE

3 Phase—60 Cycle—220/440 Volt

100 Motors up to 15 HP — all makes and types and speeds.

Qn.	H.P.	Make	Type	Speed
1	15	West.	CS	1800
1	15	G.E.	KT	1200
1	15	G.E.	KT	900
1	20	G.E.	KT 302	1800
1	20	G.E.	KT 312	1200
1	25	G.E.	KT 30N	1800
2	25	West.	CS	1200
1	25	G.E.	KT 332	900
2	25	Line.	Nema	600
1	30	G.E.	KT 312	1800
1	30	West.	CS	1800
2	30	West.	CS	1200
1	30	G.E.	KT 336	720
1	40	G.E.	KT 323	1800
1	40	G.E.	KT 336	900
1	50	G.E.	KT 327	1800
1	50	West.	CS	900
1	50	G.E.	KT	720
1	60	G.E.	KT 333	1800
1	75	G.E.	KT 337	1800
1	75	G.E.	KT	900
1	75	G.E.	IK	720
1	100	G.E.	IK	900
1	100	G.E.	KT	514
1	125	Cr. Wh.	SC	900
1	150	West.	CSJ	1800

Also larger Units available. Mail your inquiries. We also carry in stock a large number of 2300 V. motors. All types, makes and speeds. Mail us your inquiries on these machines.

MOTORS—SQ. CAGE

3 Phase—25 Cycle—220/440 Volt

50 Motors in stock up to 15 HP. Send details, we will quote.

Qn.	H.P.	Make	Type	RPM
4	20	West.	CS	750
1	25	West.	CS	1500
1	25	G.E.	KT	750
1	30	G.E.	KT	750
1	40	Al.-Chal.	AR	1500
1	40	West.	CS	750
1	75	G.E.	IK	750
1	100	G.E.	IK	750
2	150	G.E.	IK	750

Also in stock many 2300 V. motors—also all types of 25 cycle Slip-ring motors. all types and makes.

MOTORS—SLIP RING

60 Cycle—3 Phase—220/440 Volt

25 Motors — In stock up to 10 H.P.— All Speeds and types.

Qn.	H.P.	Make	Type	Speed
1	15	G.E.	MT	1800
1	15	G.E.	MT 312	1200
1	15	G.E.	MT 312	900
1	20	G.E.	MT 322	1200
1	20	G.E.	MT 326	900
1	25	G.E.	MT 326	1200
1	40	G.E.	MT 332	1200
1	40	G.E.	MT 336	900
1	50	West.	CW	1200
1	50	Al.-Chal.	ANY	900
1	50	G.E.	MT 342	900
1	60	G.E.	MT 346	900
1	75	G.E.	MT 356	900
2	75	Al.-Chal.	ANY	900
1	75	West.	CW	900
1	75	G.E.	IM	720
1	100	G.E.	MT 356	900
1	100	G.E.	IM	720
1	150	West.	HF	600
1	150	West.	CW	600
1	200	G.E.	IM	514

Also larger Units available.

MOTORS—SLIP RING

60 Cycle—3 Phase—2300 Volts

Qn.	H.P.	Make	Type	Speed
1	75	G.E.	MT 300	900
1	100	G.E.	IM	600
1	150	G.E.	IM	600
1	200	G.E.	IM	720
1	200	G.E.	IM	600
1	300	G.E.	IM	600

All types of Slip Ring controls in stock.

D.C. VARIABLE SPEED MOTORS

230 Volts

25 Motors up to 10 H.P. Any speed range.

Qn.	H.P.	Make	Type	Speed
1	10	West.	SK	500/1500
1	10	West.	SK	250/1000
1	10	G.E.	RF 11	400/1400
1	15	G.E.	RF 10	550/1650
4	15	West.	SK	500/1500
1	20	G.E.	RF	400/1200
1	25	G.E.	RF 13	400/1200
1	25	West.	SK	300/1200
1	25	Rel.	131 T	800/1600
1	25	Rel.	155 T	500/1500
1	35	West.	SK	500/1500
1	50	G.E.	RF 14	500/1500
1	100	G.E.	MPC 6	300/600

D.C.—230 V.—MOTORS

50 Motors up to 10 H.P., all speeds and makes Send inquiries.

Qn.	H.P.	Make	Type	Speed
1	10	G.E.	RC 29A	1800
1	10	G.E.	CD	1800
4	10	West.	SK 60L	1200
2	10	G.E.	CD	1200
2	10	G.E.	RC	900
1	10	G.E.	RC	1200
1	15	G.E.	CD	1800
1	15	G.E.	RC	1200
2	15	West.	SK	1200
1	15	West.	SK	900
1	20	West.	SK	1200
1	20	West.	SK	900
1	25	West.	SK	1800
2	25	West.	SK	1200
2	25	G.E.	RC	900
1	40	West.	SK	1200
1	60	West.	SK	1800
1	75	West.	SK	1800
1	100	G.E.	CD	1800
1	150	West.	SK	1800

D.C.—115 V.—MOTORS

Qn.	H.P.	Make	Type	Speed
1	5	West.	SK 20	1200
1	5	West.	SK 284	1200
2	5	West.	SK	1800
1	7½	G.E.	RC	1200
1	10	G.E.	RC	1200
1	10	G.E.	RC	900
1	15	West.	SK	1200
1	15	West.	SK	900

Above partial listing, many others available.

A.C.—60 CYCLE—3 PHASE GENERATORS

KVA	Make	Type	Volts	RPM
25	Diehl	9	220	1800
50	G.E.	ATB-P	240	1200
75	G.E.	ATB	2300	900
100	G.E.	ATB-PB	2300	900
150	G.E.	ATB-P	240	900
180	G.E.	ATB-PB	240	600

POWER EQUIPMENT CO.

519 Case Building - 82 St. Paul Street

Post Office Box 183 — Rochester, New York — Telephone Main 569

"ELECTRIC EQUIPMENT" STOCK-LIST

MOTORS

25 CYCLE MOTORS

Alternators—Synchronous

3 Phase, 25 cycle

HP	KVA	Make	Type	Volts	RPM
900	KVA	G.E.	ATI	550	500
300	HP	Elec.	Mach.	440	214
100	HP	Elec.	Mach.	440	600
75	HP	Elec.	Mach.	2200	509
20	KW	Ideal		240	1500

SQUIRREL CAGE

220-440 volt 3 phase

HP	Make	Type	Volts	RPM
200	G.E.	I-K	440	1500
150	G.E.	I-K	440	750
150	West.	CS	440	1500
125	G.E.	Kt 561	440	750
100	West.	CCL	440	500
100	G.E.	I-K	440	750
75	G.E.	I-K	440	750
75	G.E.	I-K	440	500
60	Lincl.	IN	220	1500
60	G.E.	I-K	440	750
60	G.E.	KT 353	440	750
60	F-Morse	H-16B	440	750
40	West.	CS	440	750
40	West.	CS	440	750
40	G.E.	KT 343	440	750
40	Al.-Ch.	AN	440	1500
40	G.E.	KT 337	440	1500
35	G.E.	I-K	440	750
35	West.	CS	440	750
35	G.E.	I-K	440	1500
30	Wagn.	22 VBP	220	750
30	G.E.	KT	440	750
30	G.E.	KT 343	440	750
30	West.	CS Tot.En.	440	750

Also 150 motors from 20 HP. to 1 HP. all speeds.

SQUIRREL CAGE

2200 volt AC 25 cycle, 3 phase

HP	Make	Type	Volts	RPM
100	G.E.	I-K	2200	1500
100	G.E.	KT 553	2200	1500
100	West.	CCL	2200	500
75	West.	CS	2200	750
50	West.	CS	2200	750
50	Al-Ch.	AR 226M	2200	1500
50	G.E.	I-K	2200	1500
40	West.	CS	2200	750
35	I-K	G.E.	2200	500
30	G.E.	KT 337	2200	750
30	West.	CS 753	2200	750

SLIP RING

3 phase, 25 cycle

125	Al-Ch.	AN	440	750
125	G.E.	I-M	440	1500
100	G.E.	I-M	2200	375
100	G.E.	MT 357	440	1500
75	G.E.	I-M	2200	750
75	G.E.	I-M	2200	500
75	West.	CI 756A	440	500
60	West.	CW 765A	440	750
50	Al-Ch.	ANY	220	380
50	G.E.	I-M	440	750
50	West.	CW	440	750
40	West.	CW	440	750
37	G.E.	ITC 5015	220	750
30	Al-Ch.	ARY	440	1500
25	G.E.	MT 337	220	750

25 other motors smaller than 25 HP. in Stock.

6—125 HP West. type CS, 2300 v. 60 cy. 3 ph. 3600 RPM. motors, stock shipment.

60 CYCLE MOTORS

SQUIRREL CAGE

HP	Make	Type	Volts	RPM
200	G.E.	I-K	2200	600
200	West.	CS	2200	1200
150	G.E.	I-K-16	2200	600
150	Al-Ch.	AN	2200	900
150	Al-Ch.	AR	440	900
150	G.E.	I-K	2200	1200
150	West.	CS	440	1800
150	G.E.	I-K 13A	2200	1800
125	Tmph.	TR 14	440	1800
125	G.E.	I-K	4150	450
100	G.E.	I-K	2200	720
100	G.E.	KT 556	2200	900
100	G.E.	I-K	440	900
100	Al-Ch.	AR 226D	440	900
100	G.E.	KT 543	440	1200
100	G.E.	I-K	440	1800
75	G.E.	KT 552	2200	900
75	G.E.	KT 352	440	900
75	Howell	SC	440	1800
75	West.	CS	440	1800
75	Ideal	A 306 B.B.	440	3600
60	G.E.	KT 333	440	1800
50	G.E.	I-K 15A	440	300
50	G.E.	I-K	440	720
50	G.E.	KT 542	550	900
50	G.E.	KT 336	550	1200
50	G.E.	KT	440	1800
50	F-Mse.	HO121C	440	3600
50	G.E.	KT 527	2200	1800
50	F-Mse.	B.B.	2200	3600

200 Motors 30 HP. and smaller all speeds and types in stock.

SLIP RING

400	G.E.	I-P	2200	257
300	G.E.	I-M	2200	1200
200	G.E.	I-M 17A	440	514
200	G.E.	I-M 17	550	514
200	G.E.	I-M 17	2200	600
150	G.E.	I-M 16	2200	600
150	G.E.	I-M 16	550	600
150	West.	CW	2300	720
150	Cr-Wh.	Late	440	900
150	G.E.	I-M	2200	900
150	G.E.	I-M 15	440	900
150	West.	CW 771.1e	440	1800
125	G.E.	MT 547	2300	1800
112	G.E.	ITC 5015	550	514
100	G.E.	MT 356	440	900
100	G.E.	I-M	440	900
100	G.E.	I-M	440	1800
75	Al-Ch	ANY	440	514
75	G.E.	MT 556	550	720
75	G.E.	MT 356	2200	720
75	G.E.	I-M	220	1800
60	G.E.	MT 556	440	600
60	G.E.	MT 352	440	720
60	G.E.	MT 346	440	900
50	G.E.	I-M	440	514
50	G.E.	MT 352	2200	720
50	G.E.	MT 352	220	720
50	G.E.	MT 346	2200	900
50	G.E.	I-M	440	1200
50	G.E.	MT 536	440	1200
50	West.	CW	440	1800
50	G.E.	I-M	440	1800

50 Smaller slip ring motors 15 HP. and smaller any speed.

DIRECT CURRENT MOTORS

CONSTANT SPEED—115 volt

HP		Make	Type	RPM
100	KW	G.E.	DLC	1000
75	KW	G.E.	CD 145	720
75		Sprague	LC	700
60		Rel.	Intpl.	1200
20	KW.	G.E.	DLC	650
20		G.E.	RC 31	1200
20		G.E.	RC 30	1150
15		G.E.	CVC 116	700
15		G.E.	CVC 115	925
15		W.S.H.	SK	1150
15		G.E.	RC 29	1200
10		West.	SK	1120

50 Motors—115 volt—10 H. P. and under, all speeds.

VARIABLE SPEED—115 volt

30	Nthn.	20801	250/1000
25	West.	SK	1100/2200
15	G.E.	RC 12	575/1150
15	West.	SK	1110/1650
10	West.	SK 91	250/1000
7½	G.E.	RF 9	600/1800
7½	G.E.	RA 30	650/1300
5	G.E.	RF 8	650/1950
2	G.E.	CD 73	500/2000

CONSTANT SPEED—230 volt

300	G.E.	DMC INT	800
100	G.E.	CD 123	1200
75	KW. Cr. Wh.	81 H Gen.	725
75	Cr. Wh.	516761	1050
60	G.E.	RC 34	1050
60	Al-Ch.	E 123	1800
60	West.	SK 123L	1800
50	Cr. Wh.	CMC-H50	750
50	Rinc.	310T	900
50	Al-Ch.	E 123	1200
40	G.E.	RC 15	700
40	G.E.	RC 31	700
40	West.	SK	775
40	G.E.	LC	930
40	G.E.	RC	1050
40	G.E.	DLC	1050
40	KW. West.gen.	SK	1800
35	KW. G.E. gen.	DLC	900
30	West.	SK 133	600

Also 130 other DC motors—40 HP. and smaller any speed.

VARIABLE SPEED—230 volt

175	G.E.	DLC 208	650/ 925
80	Burke	CD 60	200/ 625
60	Sprg.	Intpl.	480/1100
50	G.E.	RLC	400/1200
35	West.	SK	500/1500
35	G.E.	RLC	500/1500
35	West.	SK 150	400/1200
35	G.E.	RF 14	400/1200
30	West.	SA 8	500/1500
30	El. Dy.	208	400/1200
25	West.	SK 140	400/1200
25	El. Dy.	208	410/1200
20	West.	SK	400/1200
20	G.E.	RLC 115	600/1200
20	G.E.	RLC 203A	300/ 900
15	West.	80 L	1150/1800
15	G.E.	RF 13	300/ 900
15	West.	SK 93	600/1800

45 motors, 230 volt DC variable, all speed, 13 HP. or smaller.

MOTOR GEN. SETS

1—500 KW. West. 250 volt, 720 rpm. 720 HP. 2300 volt, 60 cycle, synchronous drive.
150 KW Ridgeway 900 speed 2300/60/3/ 900.
1—100 KW. Cr. Wh. factory built set 275 v. DC. 1800 rpm. comp. intpl. on base to 150 HP. Type SC Cr. Wh. motor, 2200 v., 60 cy., 3 ph., 1800 rpm. with starter.
1—50 KW. G. E. type RC, 250 v., 900 rpm. on base to 75 HP. KT 553 motor 2200 v., 60 cy., 3 ph., 900 rpm.

125 volt DC.

1—75 KW. G. E. type RC 18, 125 v., 720 rpm. comp. intpl. factory built to 115 HP. G. E. type I-K, sq. cg. motor, 2200 v., 25 cy., 3 ph. 750 rpm. with starter.
1—35 KW. G. E. type CD 95, 125 v., 1800 rpm. factory built comp. intpl. to 50 HP. G. E. type FT 527, sq. cg., 2200 v., 60 cycle, 3 ph., 1800 rpm. complete.
1—30 KW West. type SK factory built, 125 v., 1200 rpm. to 50 HP. West. type CS 440 v., 60 cy., 3 ph. 1200 rpm. motor, complete.
1—17 KW. G. E. type CVC set, 125 v. 1200 rpm. comp. intpl., to a 25 HP. G. E. type I-K, sq. cg. motor, 550 v., 60 cy., 3 ph., 1200 rpm.
We also have 15 Mo. Gen. Sets 15 KW. and smaller, 125 v. or 250 v. Send us your inquiries.

LOW VOLTAGE

1—600 Ampere, G. E. generator DC.
1—800 Ampere G. E. generator DC.
1—1000 Ampere, 70 volt, Burke synchronous motor generator set.
1—1600 Ampere, 60 volt, 1200 rpm. G. E.

AC GENERATORS

60 CYCLE

HP	KVA	Make	Type	Volts	RPM
300	KVA.	G.E.	ATB-PB	480	720
250	HP.	West.	4846672	240	1800
240	HP.	G.E.	ATI	200	514
225	KVA.	G.E.	ATB	200	720
200	KW.	G.E.	ATB-PB.	550	720
200	HP.	G.E.	ATI syn.	2300	900
150	KW.	West.	640451	2200	600
150	KW.	G.E.	ATI	2300	900
150	KW.	G.E.	ATB-PB	600	900
120	KW.	G.E.	ATB-PB	2300	720
105	HP.	El.Ma.	BRT	2300	1800
100	HP.	G.E.	ATI PB	2300	900
100	HP.	G.E.	ATI-PB	220	900
75	KW.	G.E.	ARB-PB	2300	900
75	KW.	G.E.	ATB-PB	550	900
60	KVA.	G.E.	ATB-P	2300	900
60	HP.	G.E.	ATI-PB	4000	900
54	KVA.	G.E.	ATB	220	900
50	KW.	G.E.	TRB	240	1200
50	KVA.	West.	Ac gen.	240	1200
37½	KVA	G.E.	ATB-PB	240	1200
25	KW.	G.E.	TAB	240	1800

40 Generators AC. in stock 20 KW. or smaller. Write for details.

1250 HP IDEAL, 4000/2300 Volt, 1200 RPM, Direct Conn. Exciter
1250 HP Syn. AC Generator

SPECIALS

BOILERS:
3—150 HP. Wickes H.R.T.

STOKERS:
3—Combustion Engine Ring.

TRANSFORMERS:
70—50 KV. G.E. 2300/115/230
38—50 KVA G.E. 60 cy. 2300/ 115/230.
35—50 KVA. G. E. steel case transformers 2300/115/230 volt, 60 cycle, single phase.
4—200 KVA. West. 4000-115/ 230 volt, 60 cycle, transformers.

ENGINE GENERATORS:
1—625 KV. Corliss 220 V., 60 cy.
1—600 KVA Corliss, G.E. 60 cy. 220V.
1—1000 KW. Westinghouse 250 volt, 90 rpm. D.C.
1—1000 KW Wsghse, 250 V., Penn Harris, cross comp.
1—625 KVA. G. E. Corliss, 220 volt, 60 cycle, 3 phase, 100 rpm.
1—250 KW. Corliss 230-V. D.C.
1—1600 AMP. 60 V., 1200 R.P.M. D.C. Generator.

OUR STOCK INCLUDES THE FOLLOWING

TRANSFORMERS
METERS
MOTORS
SAFETY SWITCHES
PANEL BOARDS
ALTERNATORS
CAPACITORS
COMPENSATORS
GAS ENGINES

We will buy for cash and resell to defense plants.

ELECTRIC EQUIPMENT CO.

63 CURLEW ST. · PHONE: Glenwood 6783 ROCHESTER, N. Y.

DEPENDABLE

Turbo-Generators

A PARTIAL LIST OF OUR INVENTORY

1—G.E. 3125-KVA, 3600-RPM, Condensing: 3/60/2300-v, 200#, 100° SH, 28" vacuum: Surface or Low Level Jet Condenser.

1—Westinghouse 2500-KVA, 3600-RPM, Condensing: 3/60/600-v, 200#, 100° SH, 28" Vacuum: Low Level Jet Condenser.

1—G.E., 1875-KVA, 3600-RPM, Condensing: 3/60/600-v, 200#, 100° SH, 28" Vacuum: Surface or Jet Condenser.

1—G.E., 1563-KVA, Non-condensing 3600-RPM, 3/60/600-v: 150#, 100° SH, 20# back pressure.

1—Allis-Chalmers 1250-KVA, 3600-RPM, 3/60/2300-v, 200#, 500° TT: Surface Condenser.

1—Westinghouse, 1250 KVA 250-v, direct current, condensing, 150/250-Lbs., Surface Condenser.

1—Allis-Chalmers 937-KVA, 3600-RPM, Condensing: 3/60/2300-v. 200#, 500° TT: Surface Condenser.

1—G.E., 625-KVA, 3600-RPM, Condensing: 3/60/2300-v. 200#, 500° TT, 28" vacuum.

1—G.E., 250-KVA, Non-condensing, 3600-RPM: 3/60/480-v, 150#, 0° SH, 28" Vacuum, 10#G, back pressure.

WILMS, WEAVER & CO. Penobscot Building DETROIT, MICH.

We Deal in Turbo-Generators Exclusively

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N.Y.

A C TURBINE UNITS

6250 KVA G.E. 2300 V. Cond.
3125 KVA G.E. 2300 V. Cond.
1875 KVA Al. Chal. 2300 V.; Cond.
937 KVA G.E. 2300 V.; Cond.
937 KVA Wghse. 6600 V.—250 lbs.
937 KVA Al. Chal. 2300 V.—300 lbs.
780 KVA Al. Chal. 2300 V.; Cond.
625 KVA Wghse. 2300 V.; Cond.
500 KVA Wghse. 480 V.; Non-Cond.
375 KVA G.E. 2300 V.; Cond.
375 KVA G.E. 2300 V.; Non-Cond.
312 KVA Elliot 480 V.; Cond.
312 KVA C.W.-Moore, Non-Cond. (450#)
175 KVA Al. Chal.-Sturtevant 220 V.;
112 KVA Al. Chal. 240 V.—Terry

STEAM ENGINE SETS

500 KVA G.E. 240 V.—Ames Unif.
375 KVA G.E.-E.B. 4 Valve; 480 V.
300 KW G.E.-Skinner Uniflow; 250 V. DC
255 KVA G.E.-Hamilton; 240 V. AC
210 KVA G.E.-Skinner Uniflow; 480 V. AC
200 KW Elliot, 250 V., 3 W.—Elliot 4 V.
150 KW G.E. 250 V. 3 W.—Erie Ball 4 V.
150 KVA G.E.-Skinner; 220 V.
125 KW G.E.-E.B. 4 Valve; 250 V. DC
100 KW G.E.-E.B. 4 Valve; 250 V. DC
100 KW G.E.-E.B. 4 Valve; 125 V. DC
100 KW Elliot 250 V. 3 wire—Elliot 4 V.

STEAM ENGINES

Twin 22 x 36 Nordberg Uniflow
21 x 22 Skinner Uniflow
18 x 20 Ames Uniflow

SPECIAL — 937 KVA GENERAL ELECTRIC 3-60-2300 V. CONDENSING TURBO GENERATOR SET; EXCITER; SURFACE CONDENSER; SWITCHBOARD.

500 KVA Wghse. 3-60-480 V. Non-Cond. Turbine Unit, Exciter, Switchboard.

210 KVA G.E. 3-60-480 V. Alternator-19x20 Skinner Uniflow Engine; Exciter, Switchboard.

DIESEL ENGINE SETS

375 KVA Wghse. 3 ph., Busch-Sulzer
312 KVA Burke 3 ph.—Anderson
200 KVA G.E. 3 ph.—Busch-Sulzer
170 KVA F.M. 3 ph. style VA.
90 KVA F.M. 3 ph.—F.M. Style VA
40 KVA F.M. 3 ph.
50 HP F.M. "VA" belted

TRANSFORMERS

687 KVA (2) Maloney 13,800-460 V.
600 KVA (2) Pittsburgh 2300-550 V.
500 KVA (3) Al. Chal. 33,000-440 V.
333 KVA (3) G.E. 11000/22000/33000-115/230/460 V.
250 KVA (3) Packard 22,000-2300 V.
250 KVA (2) G.E. 6600-2300 V.
200 KVA (3) G.E. 2400/4160-600 V.
150 KVA (2) Maloney 2300-230/460 V.
100 KVA (3) Al. Chal. 22,000-440 V.
50 KVA (4) Packard 6600-110/220 V.

BOILERS

749 HP (2) Edgemoor 200 lb.
728 HP E.C. ver. 200 lbs.
600 HP Heine 200 lbs.
600 HP Connelly 200 lbs.
562 HP Edgemoor 200 lbs.
500 HP (4) Vogt 225 lbs.
471 HP E.C. ver. 160 lbs.
250 HP (2) E. C. 200 lbs.
344 HP (2) B & W 160 lbs.

AIR COMPRESSORS

2200 CFM Nordberg 100#—Motor & Steam driven
1080 CFM Nordberg 85#—165 HP, 230 V. DC Motor
250 CFM Chicago Pneu. 100#—75 HP AC Motor

PUMPS (motor driven)

3600 GPM 85' head
3250 GPM 425' head
3000 GPM 100' head
2200 GPM 400' head
1390 GPM 233' head
1000 GPM 231' head
850 GPM 243' head
750 GPM Hill 231' head
650 GPM DeLaval 810' head
600 GPM Al. Chal. 450' head

Let MacCABE lift your Worries!

GENERAL PURPOSE 230-VDC. MOTORS

H. P.	Make	Type	R. P. M.
1—½	C. W.	C. M.	400-SH.
1—1	C. W.	E	1200-SH.
2—2	Allis. Chal.	E-50	1750-SH.
2—3	Westgshe	CD-92	1725-SH.
1—3	G. E.	CD-55	1150-SH.
1—3	Reliance	T-224	3500-SH.
3—5	Westgshe	SK-40	850-SH.
2—5	Westgshe	SK-30	1100-Comp.
4—5	Westgshe	SK-30	1100-SH.
2—7½	Westgshe	SK-60	850-Comp.
1—7½	Westgshe	SK-40	1150-SH.
1—10	Westgshe	SK-50-L	1300-SH.
1—15	Allis. Chal.	Shunt	800
1—15	C. W.	Size 15-J	800-Comp
1—15	G. E.	OD-75	1750-SH.
2—25	Westgshe	SK-100-L	100-SH.
2—25	Westgshe	SK-120	825-Comp.
1—40	Reliance	RH-992	200-Comp
1—75	Westgshe	SK	850-Comp.

220/440-V. 3-PH. 60-CY. MOTORS CRANE AND GENERAL PURPOSE

1—3	Ideal	A. E. Crane	1600
1—3	G. E.	K. Q.-730	1730-(2-Ph.)
1—7	Wagner	11-V. R. P.	860
1—5	G. E.	K. Q.-946	1200
1—5	G. E.	M. T. C.-5201	675 (25-CY.)
1—7½	G. E.	K. T.-944	1800
1—10	F. M.	OS-FW-324	1740
1—10	F. M.	OLS-326	1200
1—10/20	G. E.	K. T.-5224	600/1200
1—11	Louis Allis.	Crane	1200
1—11	P. & H.	H. W.-10-A	820
1—15	Electro Dy.	F. R.-1601	1145
1—20	G. E.	1	1200
1—22	P. & H	H. W.-20	840
1—25	F. M.	H	900
2—25	F. M.	H	1200
1—25	Westgshe	C. I.	690
1—25	Westgshe	C. S.	900
2—25	G. E.	K. T.-326	1160
1—30	Westgshe	C. I.	690
1—30	Westgsh	C. I.	1150
2—37	G. E.	I. T. C.-5011-A	700 (25-CY.)
2—35	Westgshe	C. I.-885	900
1—35	G. E.	1-form-K	1800
1—40	G. E.	ITC-5012	600
1—40	G. E.	K-444	1800
1—35	F. M.	H-12-B	1200
1—50	G. E.	KT-346	870
1—52	G. E.	ITC-5045	600
1—75	Westgshe	C. W.	820

230-VDC. CRANE & MILL MOTORS

H. P.	Make	Type	R. P. M.
1—1	P & H	5½x3½	850
2—2	Shaw	BE	930
1—2½	G. E.	C. O. 2502	750
1—2½ (New)	Reliance	T-224	1600
4—3	Shaw	BE	930
1—3½	G. E.	C. O.-2503	975
1—5½	G. E.	C. O.-2504	725
1—6	C. W.	M. L.	930
1—6	G. E.	C. O.-1805	1150
1—7½	G. E.	C. O.-1806	700
1—10	G. E.	C. O.-2503	850
2—10	G. E.	M. D.-102	700
5—11/15	Westgshe	K-5	700
1—19	C. W.	BW	650
1—20	G. E.	C. O.-2504	850
1—20	Westgshe	K-6	675
1—20/25 (New)	Westgshe	K-5	975/875
2—20/30	G. E.	M. D.-104	725/575
4—25	G. E.	C. O.-1809	550
2—65/85	G. E.	C. O.-1830	700/650
1—85	G. E.	C. O.-1811	550
1—150	Westgshe	MCB-100	365

WE HAVE IN STOCK 150-DRUM AND FACE PLATE TYPE REVERSING CONTROLLERS, MANY WITH RESISTOR BANKS: 6 TO 100-HP. ELECTRIC BRAKES. 115/230/550-VDC.

VARIABLE SPEED 230-VDC. MOTORS

1—2	G. E.	R. F.	500/2000-SH.
1—3	G. E.	RLC-111	750/1500-SH.
1—3¾	G. E.	RLC-112	600/1800-SH.
1—5	Reliance	Frame F	500/1800
1—5	Reliance	Frame F-943	450/1800
1—5	Westgshe	SK-33	150/1650-SH.
1—7½	Reliance	F-953	450/1850-SH.
1—7½	Reliance	G-903	275/1650-SH.
1—7½	Westgshe	SK-103	400/1600-SH.
1—8	Westgshe	SK-100-L	300/1200-SH.
1—10	Reliance	G-900	400/1200-SH.
1—70	Reliance	461-T	600/1200-SH.

(E.C. & AUTO PANEL WITH 70-HP. MOTOR)

AUTO CONTROL AVAILABLE FOR MOST THESE MOTORS

SPECIAL: 200-Allis Chal. slip ring, const. duty, 700, (2300 volt with control equipment)

T. B. MacCABE COMPANY

4306 CLARISSA STREET PHILADELPHIA 40, PA.

Motor Generator Sets—Synchronous Motors, etc.

VERTICAL MOTORS

1—G. E. 50 HP 1200 RPM 3 ph 60 cy 220 V.
1—Reliance Fan-cooled 25 HP 1750 RPM 220/440 V.

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A.C.

1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS, 3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 60 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220/1440 Volts

1—150 HP 1750 RPM Allis-Chalmers
2—100 HP 550 RPM Westinghouse MS
1— 75 HP 575 RPM Westinghouse CS—368-A
1— 75 HP 600 RPM Fairbanks-Morse
1— 75 HP 720 RPM Lincoln I-P
1— 65 HP 860 RPM Allis-Chalmers
1— 50 HP 690 RPM Westinghouse CS—758
1— 50 HP 875 RPM Westinghouse CS
1— 50 HP 865 RPM Ideal
4— 20 HP 870 RPM West. T.E.F.C. CS—W-405
2— 20 HP 870 RPM West. CS—W-405
2— 15 HP 860 RPM Allis-Chalmers

ALTERNATOR SPECIAL, Allis-Chalmers, 125 KVA, 277 RPM, 3 phase, 60 cycle

The Electric Motor & Repair Co., Cuyahoga Falls, O.

IMMEDIATELY AVAILABLE

240 HP Model 32 Fairbanks Morse Diesel Engine with 200 KVA 3/60/240 V generator $7500.
120 HP Model 32E12 late design Fairbanks Diesel with two 30"x10" clutch pulleys. $3500.
Including 37½ KVA 3/60/220 V gen & board $4000.
870 HP 725 KVA 2300 volt three unit Diesel Generator Plant $38,000.
1574 CFM (1250 CFM actual delivery) Sullivan WN3I direct Synchronous Motor driven 100/150 lb. Air Compressor, 3/60/2300 V $10,000 reconditioned and guaranteed.

MISSISSIPPI VALLEY EQUIPMENT CO.

511 Locust St. St. Louis 1, Mo.

Have you anything for sale?

BOILERS

1—813 HP Edgemoor Boiler, 200# pressure, Riley underfeed stoker.
1—335 HP B & W Sectional Header Boilers, 200# pressure with superheaters, hand fired grates.
2—516 HP Sterling 200# pressure boilers, ASME Code, with chain rate stokers.
1—400 HP Wickes 3 drum low head boiler, 200# pressure with Chicago Spreader stoker. Installed 1932.
1—90,000# per hr. Badenhausen Boiler, 354# pressure.
1—357 HP HEINE with Riley Underfeed Stoker.
1—1000 HP Badenhausen Riley 200# pressure with pulverizer.
2—300 HP Heine 175# pressure.
2—492 HP Sterling Boilers, 160# pressure stokers.
1—725 HP Sectional Header Boiler 225# pressure with underfeed stoker.
1—394 HP Sterling Boiler chain grate stoker, 160# pressure.
2—250 HP Sterling Boilers, 160# pressure equipped with gas burners and controls.
2—253 HP Sterling Boilers, 160# pressure with oil burners.
2—250 HP Wicks Vertical Boilers, 160# pressure with pulverizers.
2—500 HP Edge Moor Boilers 200# pressure.
4—500 HP Voigt Water Tube Boilers 175# pressure with chain grate stokers and all auxiliaries.
1—440 HP B & W Sectional Header Boiler 150# pressure, underfeed stoker.
1—522 HP Sterling Boiler 200# pressure with Firite Stoker.
2—404 HP Springfield, 200# pressure with chain grate stokers.
1—484 HP Springfield Boiler, 250# pressure oil burners.
2—350 HP HEINE Boilers, 150# pressure.
1—Complete Power Plant consisting of 2—309 HP Heine Marine Boilers, 223# pressure and 2 General Electric Turbines with all auxiliaries.
8—150 HP HRT Boilers, 150# preessure.
1—300 HP Locomotive Boiler 150# pressure with all trimmings.
3—250 HP Erie City vertical boilers with pulverizers.
1—400 HP Connelly Boiler 160# pressure with new tubes and auxiliaries.
2—84" x 20' HRT Boilers, 150# pressure all auxiliaries.
2—150 HP Brownell Boilers, 125# pressure, rebuilt and guaranteed.
56—50 HP Vertical Boilers 150# pressure all auxiliaries.

TURBINES

1—5000 KW Westinghouse 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
1—2500 KW General Electric Condensing Turbine with auxiliaries.
1—2500 KW General Electric Turbine 400# pressure. Surface condenser.
1—1000 KW Westinghouse non-condensing turbine 350# pressure 16# back pres.
1—937 KVA Allis-Chalmers Turbine.
1—625 KVA General Electric Turbine with jet condenser.
1—2000 KW Westinghouse Turbine with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP Kerr Non-condensing 3600 RPM Turbine.
1—250 KVA Waite Turbine either condensing or non-condensing.
1—250 KVA General Electric non-condensing Turbine.
1—125 KW General Electric non-condensing Turbine.

ENGINE GENERATOR SETS

1—200 KVA Harrisburg Uniflow Engine Generator Set.
1—750 KVA Rice & Sargent 3-60-600 volt engine generator.
1—480 KW Rice & Sargent 3 60-550 volt engine.
1—375 KVA Chuse Corliss eng. generator.
1—375 KVA Chuse vertical Uniflow engine.
2—312 KVA Skinner Uniflow engines.
1—166 KVA Ames Uniflow engine generator set.
1—220 KVA Chuse non-releasing Corliss engine generator.
1—100,000 gallon Water Tower 100' high.
1—48" x 150' steel stack.

DIESEL ENGINES

2—200 KVA Fairbanks-Morse Full Diesel Engine Generator.
1—450 HP Cooper-Bessemer Tex rope driven to 300 KW AC Generator.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
4—500 HP Busch-Sulzer 6 cylinder oil engines used only 300 hours.

ENGINE GENERATOR SETS

1—625 KVA Nordberg Uniflow engine.
1—1000 KVA Skinner Uniflow engine.
400 KW Skinner Uniflow Engine Generator set.

MISCELLANEOUS

2—400 GPM Centrifugal Boiler Feed Pumps.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
1—#8 Fuller Bonot Pulverizer.
2—Type AA-6 10 retort Taylor Underfeed Stokers.
1—3 Retort Detroit Stoker.

SEE Fletcher FIRST!

FLETCHER SALES CO.

325 Fincastle Building LOUISVILLE, KY.

CHICAGO ELECTRIC—GUARANTEED REBUILT EQUIPMENT

MOTOR-GENERATOR SETS

KW	Make	DC volts	AC volts
1000	G.E.	600	4400/2200
1000	Wtg.	275	4160/2300
750	G.E.	275	440
300	Al. Ch.	600	2300 syn.
250	G.E.	600	
200	3-unit	80v.	DC250 v. DC
235	Westg.	110	2200
225	Ideal	115	2200
200	Westg.	250	440/2200
150	Cr. Wh.	250	2300
150	Ideal	250	440
150	Rldg.	250	2300
100	G.E.	250	2200
100	Westg.	125	2200
100	Al. Ch.	125	440
100	Westg.	250	220/440/2200
90HP	Westg.	110	75 Kva 2200 ac
75	G.E.	250	2200
75	G.E.	125	220
50	Al. Ch.	3-w.	2200
50	G.E.	125	4000
50	Westg.	250	2300
15	G.E.	230	220
15	Ster.	240	220
7½	Jenny	balance set	

SLIP RING MOTORS

	HP	Make	Type	Speed
1	50	Al. Ch.		720
1	60	Westg.	CW	600
3	75	Al. Ch.	ARY	900
1	75	Westg.	F	720
1	75	G.E.	M-12	600
1	75/94	N. West.	HW	1800
1	100	G.E.	I	600
1	100	Al. Ch., 2200 v		600
1	100	Westg. 2200	CW	600
1	100	Westg.	HF	230
1	150	G.E.	MT	900
1	150	Westg.		600
1	150	Al. Ch.		580
1	150	Westg. 2200	CW	375
1	200	G.E.	IE	1200
1	200	Howell	S	600
1	200	Westg.	CW	345
1	250	Al. Ch. 2200/400		600
1	250	G.E. Slipring vert.		1200
1	300	G E Slipring	I-M2200	514
1	300	G.E., 3-brg.	MT-410	450
1	300	G.E. with outboard brg.	I-P	450

FREQUENCY CHANGERS

1—1400 HP General Electric type ATI-24-1250M-300 Form C, 3 ph. 60 cy, 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. 50° synchronous motor with amort. wdg., dir/conn. to 1000 KW General Electric type ATI-10-1250M-300, 3 ph, 25 cy, 460 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G. E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

25 CYCLE—M. G. SETS

1—75 KW General Electric type CL6, 125 v., compound wound, D.C. generator, 2 brg., dir. conn. to 110 HP type I-K, 3 phase, 25 cycle, 230 v., 750 RPM sq. cage motor.

1—75 KW General Electric type DLC-206A, compound interpole, 3 brg. D.C. generator, dir. conn. to 115 HP type I-K, 3 phase, 25 cycle, 440 volt, 750 RPM, sq. cage motor.

BOILER FEED PUMPS

1—16x10x12 Union Vacuum Pump, brass lined cylinders, force feed lubricator.
1—8½x5x10 Union boiler feed pump, brass lined cylinders, force feed lubricator.

BOILERS

1—516 HP B. & W. Sterling 200 lb., with Coxe stoker.
1—725 HP Kingsford-Webster, designed 200/225 lb., with Detroit underfeed stoker.
2—500 HP Voght class H4, designed 200 lb., with soot blowers, superheaters, etc.
1—100 HP Scotch Marine boiler dry back type 150 lb.
2—125 HP Sterling B. & W. 125 lb.
1—200 HP Heine 160 lb. hand fired.
1—200 HP Scotch Marine good for 200 lb.
2—309 HP Heine marine type water tube, hand-fired.
3—300 HP B. & W. 160 lb. pressure with stokers.
2—492 HP Sterling boilers, 160 lb. pressure with stokers.
1—312 HP Sterling B. & W. 160 lb. with Stowe stoker.

ROTARY CONVERTERS

165 KW G.E. type HCC-6-165, comp. wd. intp. 6/60 AC 250 v. DC. 1200 RPM, 440 v. transfs.
50 KW N.W. 3/60/220 1200 RPM AC to 115 v. DC.

PUMPS

Can furnish with motor

GPM	Head	Make	Type
1500	80	Alberger	KT
1000	525	F. Moose	bb
10500	35	Amer. Will	Al. Ch.
150	80	Gould (2)	#3030
50/100	230	Gould	#1616
150	250	Swaby	#1961
400	100	Haydon	
900	70	Union	19TBP
10/40	120/70	Yeomans (2)	HVS
25/50		Economy	15/20#
125	180	Jennings	78#
100		Blackmer gasoline pump	#100

SQUIRREL CAGE

1	60	Westg. (B.B.)	CS	435
1	75	G.E. vert. hollow shaft		1800
1	75	Westg. 2200 v.	CS	1800
1	75	Westg.	CCL	850
1	75	G.E.		720
2	75	Westg.	CCL	690
1	75	Westg., double shaft ext.	MS	680
1	75	Al. Ch.	AN	680
3	75	Al. Ch.	345	
5	75	G.E.		600
1	100	Al. Ch.		1800
1	100	Al. Ch., vert.		1200
3	100	Westg., 2200/220/440	CS	1200
1	100	West. El.	KT	900
1	100	G.E., 2200 v.	IK	900
1	100	Al. Ch., 2200 v.		450
2	125	G.E., 2200 v.	KT547	1800
2	125	G.E., 2200 v.	KTP	1800
4	125	G.E.	KT	720
1	150	Westg., 2200 v.	CS	1716
1	150	Al. Ch.		1200
1	150	G.E.	K-558	900
1	150	Westg., 2200 v.	CS	1800
1	150	G.E.	IK	600
2	150	Westg.	CCL	495
1	200	Westg.	CS	3800
3	200	F. Morse, B.B.		1800
1	200	G.E., 2200 v.	KT	1800
1	200	G.E.	IK	1200
1	200	G.E.	IK	600
1	200	Westg.	CS	600
1	225	G.E., 4160 v.	FT	3600
1	225	G.E., 2200	I-E	1800
4	250	Fair. M. B. B., 2200 v.		1800
1	250	Ideal	A	1200
1	250	F. Morse B. B. 3-brg.		900
2	400	G.E., 2200 v.	I-K	1800
1	400	Al. Ch.		600
1	700	G.E., 2200, drip-proof constr.	KF	1800
1	1000	G.E., 2200 v.	K	500

2200 VOLT COMPENSATORS
3 Phase, 60 Cycle

HP	Make	Type
150	Gen. Elec.	NR 4747
150	Gen. Elec.	CR 1034-K17
125	Westinghouse	A
125	Gen. Elec.	CR 1034-K17
75/100	Westinghouse	E
100	Gen. Elec.	NR 2724
75	Westinghouse	E
75(3)	Gen. Elec.	NR 2723
75	Gen. Elec.	CR 1034-K17
75	Gen. Elec.	NR 2742
60/75	Gen. Elec.	NR 6693-N13
60	Gen. Elec.	CR 1034-K17
30/50	Westinghouse	E
40/50	Westinghouse	E (2 of these)

CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO, ILL.

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.
1—18750 KVA Westinghouse Cond.
1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 6000 KVA Westinghouse Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
2— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA Westinghouse Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA General Electric Cond.
1— 1500 KVA Allis Chalmers Non-C.
2— 1250 KVA General Electric Non-C.
1— 938 KVA West. 375# I.P. 100# B.P. N-C.
1— 625 KVA General Electric Non-C.
1— 470 KVA Westinghouse Non-C.
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.
1—1067 KVA Nordberg Uniflow
1— 400 KW Ames Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 250 KVA Ridgway 4-valve
1— 210 KVA Skinner Uniflow
1— 94 KVA Chuse Uniflow

D.C. STEAM ENGINE UNITS
1—350 KW Ridgway 4-valve 250 V.
1—300 KW Skinner Uniflow 250 V.
1—250 KW Ames Uniflow 250 V.
1—200 KW Ridgway 4-valve 250 V. 3-wire
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL & GAS ENG. UNITS—60 Cy.
1—500 KVA West. (gas) 440 V.
1—312 KVA Anderson 2400 V.
1—200 KW Worthington 2300 V.
2—200 KVA Fairbanks Morse VA 2400 & 220/440 V.
1—187 KVA McInt.-Seymour 2300 V.
1—125 KVA Sterling Petrel (gas) 480 V.
1—121 KVA Fairbanks Morse 240 V.

WATER TUBE BOILERS
2—1452 HP B. & W. 350-lb., Stokers
1— 868 HP Connelly 250-lb., Stoker
2— 750 HP Edge Moor 200-lb.
1— 612 HP Stirling 200-lb., Pulverizer
2— 500 HP Stirling 200-lb., Stokers
1— 440 HP B. & W. 160-lb., Hand Fired
1— 400 HP Wickes 200-lb., Stoker
1— 336 HP B. & W. 200-lb., McClave-Brooks Stoker
4— 200 HP B. & W. 200-lb., Hand Fired

SYNCHR. MOTORS—60 Cy.
1—1000 HP Westinghouse 2300 V. 720 RPM
1— 800 HP General Electric 440 V. 120 RPM
1— 750 HP Westinghouse 2300 V. 720 RPM
1— 200 HP General Electric 2200 V. 1800 RPM
1— 175 HP General Electric 230 V. 225 RPM
1— 175 HP General Electric 220 V. 200 RPM
1— 100 HP General Electric 2300 V. 240 RPM

INDUCTION MOTORS—60 Cy.
4—3500 HP G. E. slip ring 2300 V. 120 RPM
1— 600 HP G. E. sq. cage 440 V. 900 RPM
2— 400 HP G. E. slip ring 3807 V. 1800 RPM
2— 300 HP G. E. sq. cage 440 V. 600 RPM
2— 250 HP G.E. sq. cp. 2300/4000 V. 1200 RPM
1— 250 HP G. E. slip ring 2200 V. 450 RPM
3— 50-150 HP West. 2200 V. 343-679 RPM

MOTOR GEN. SETS—60 Cy.
1—1500 KW General Electric 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 500 KW General Electric 600 V. DC
1— 500 KW General Electric 250 V. DC
1— 75 KW General Electric 125 V. DC

ROTARY CONVERTERS—60 Cy.
1—1500 KW Westinghouse 250 V.
1—1000 KW Westinghouse 600 V.
2—1000 KW Westinghouse 250 V.
1— 750 KW Westinghouse 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

OIL CIRCUIT BREAKERS
2— 600 A. 73 KV West. G222AS Outdoor
2— 400 A. 73 KV G. E. FKO36 Outdoor
1— 400 A. 73 KV G. E. FHKO-36 Outdoor
6— 400 A. 37 KV G. E. FHKO-136 Outdoor
4— 400 A. 34.5 KV Conduit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB-76 Outdoor
1—2000 A. 15 KV West. E 6 Indoor
1—1500 A. 15 KV West. E 6 Indoor
4— 600 A. 15 KV G. E. FKO-60-B Outdoor

FREQUENCY CHANGERS
2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA G. E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1500 KW G. E. 25/60 cy. 300 RPM
1—1250 KVA G. E. 25/62½ cy. 750 RPM
1—1000 KW G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 25/60 cy. 300 RPM

SYN. CONDENSERS
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.
1—10000 KVA West. 120,000/66000-13200 V. 3 ph.
3— 750 KVA Pitts. 66000/33000 V.
1— 200 KVA G. E. 66000-13200/22800 V.
6— 250 KVA Penn. 34500/17250-4600/2300 V.
3— 75 KVA G. E. 33000-13200/11000 V.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 6000 KVA West. 13200-2300 V. 3 ph.
3— 1500 KVA Pitts. 22000-6600 V.
2— 1000 KVA G. E. 23000/11500-575 V.
6— 833 KVA G. E. 22000-2300/4000Y V.
3— 667 KVA Packard 23000-440 V.
3— 250 KVA G. E. 22000-11000 V.
1— 5000 KVA American 13800-2300 V.
6— 1667 KVA Pitts. 13200-2300 V.
5— 1000 KVA G. E. 13200/2300 V.
3— 200 KVA G. E. 13200-2300 V.
3— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3— 1250 KVA G. E. 6600-550 V.
3— 667 KVA G. E. 2300/4000Y-500/480/460 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & Co., INC.

50 CHURCH STREET, NEW YORK CITY

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE, 60 CYCLE, 220/440 V.

HP	Make	RPM	Type	Frame
5	West.	1200	CCL	2 phase
5	American	600	totally enc.	ball bearing
7½	Gen. Elect.	1800	KT	944
7½	Gen. Elect.	1800	KQ	944 2 phase
10	Fairbanks Morse	900	KBY	
10	Crocker Wheeler	900	ma	365
10	Burke	1800		
15	Reliance	1200		2 phase
15	Howell	900		2 phase
20	Gen. Elect.	1800	KQ501	2 phase
20	Gen. Elect.	565		Form K
25	Gen. Elect.	1740	KQ312	2 phase
25	Armor	1200	ball bearing	2 phase
25	Gen. Elect.	1800	KT	312
30	Gen. Elect.	3600	KT	513
30	Armor	695	ball bearing	2 phase
50	West.	1200	MS	
50	Fairbanks Morse	1800	ball bearing	
50	Fairbanks Morse	1800	ball bearing	
50	West.	1800	CS	
60	Gen. Elect.	1800	I	form K
75	Gen. Elect.	1800	I	form K
75	Gen. Elect.	900	KT	552
100	Gen. Elect.	1800	I	form K
100	West.	1800	CS	
150	Gen. Elect.	1200	I	form K
150	Gen. Elect.	1200	I	form K

MOTOR GENERATOR SETS
1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC.—Motor 3/60/2300/900 RPM complete with panels.
1—32 KW Westinghouse M. G. Set. Generator Type SK, 250 V. DC. 1750 RPM—Motor 49 HP. Type CS. 3/220/440/60/1750 RPM complete with panels.

ENGINE TYPE MOTOR
625 Hp. Gen. Elect. Synchronous 3 Ph. 60 Cy., 2300 Volt, 180 Rpm.

Mine Slope Hoist
1—Connellsville Mfg. and Mine Supply Hoist —Storage capacity for 11,000 feet 1" Rope— Speed 900' per minute.
Motor—500 HP Gen. Elect. Mt. Slipring 3/60/2200/450 RPM. Complete with remote control, Herringbone reduction gears and demountable base and drum.
Write Wire Phone
Inspection can be made for 30 days in operation. This machine almost new.

TRANSFORMERS

Amt.	Kva.	Make	Cycle	Voltage
3	25	Gen. Elect.	25	2300/115/230/460
3	40	Gen. Elect.	25	2300/230/460
3	50	Gen. Elect.	60	2300/230/460
3	250	Gen. Elec. (new)	60	13,200/2300
3	200	Kuhlman	60	4160/4600/230/460
3	500	Pittsburgh	25	11,500/220
3	1000	Pittsburgh	60	2300/4600/230/460

3 PHASE, 25 CYCLE, 220/440 VOLTS

HP	Make	RPM	Type	Frame
5	Al. Chal.	720	AR	
5	Wagner	1450	Ball B.	Enclosed
7½	West.	750	CS	
7½	G. E.	1500	KT	181
10	G. E.	750	KT	312
10	West.	750	CS	
10	West.	1500	CS	
10	G. E.	1500	I	Form K
15	G. E.	750	KT	
15	West.	1500	CS	
20	West.	750	CS	
25	West.	750	CS	
50	G. E.	750	I	Form K
50	West.	750	CS	
75	G. E.	750	KT	357
75	G. E.	750	I	Form K
100	G. E.	300	I 17	Form K
150	G. E.	750	I	Form K
150	G. E.	750	I	Form K
200	West.	460	CS	2200 Volt
200	G. E.	750	I	Form K
225	Elec. Ma.	500	2200 V.	Synchron
1150	G. E.	375	2300 V.	Synchron
200	West.	285	CW	Slipring

Prices on Application

SLIPRING MOTORS
60 CYCLE, 3 PHASE, 220/440 VOLTS

HP	Make	Speed	Type	Frame
10	Gen. Elect.	1800	MT	303
15	Gen. Elect.	1800	I	form M
20	Gen. Elect.	545	MT	332
20	Westinghouse	575	CW	648A
20	Westinghouse	575	CW	ball bearing
25	Westinghouse	690	CW	
30	Gen. Elect.	1800	MT	327
30	Gen. Elect.	1800	I	form M
40	Westinghouse	690	CW	748
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
50	Westinghouse	900	CW	
60	Westinghouse	720	CW	2200 volt
75	Westinghouse	1800	CW	
500	Westinghouse	600	CW	

25 Cycle Steel Mill Motors

Amt.	HP	Make	RPM	Type	Voltage
1—	225	Elect. Mach.	500	Synchronous	2300
2—	750	Gen. Elect.	125	Slip Ring	2300
1—	1000	Allis Chalmers	293	Slip Ring	6600
1—	1150	Gen. Elect.	375	Synchronous	2300
1—	1250	Allis Chalmers	294	Slip Ring	6600
4—	1600	Gen. Elect.	93	Slip Ring	2300
1—	2000	Allis Chalmers	294	Slip Ring	6600
1—	2500	Allis Chalmers	295	Slip Ring	6600
1—	2500	Allis Chalmers	146	Slip Ring	6600
1—	3000	Allis Chalmers	184	Slip Ring	6600
1—	5500	Alis Chalmers	370	Slip Rng	6600

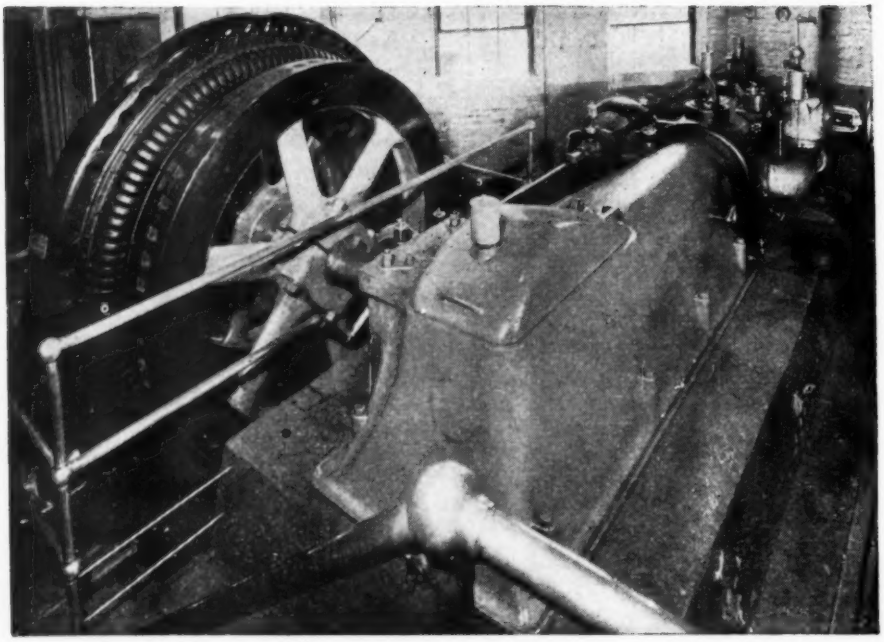
FREQUENCY CHANGERS
2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM, direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 290 HP. Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.

25 CYCLE CRANE MOTORS
10—25 Hp. Gen. Elect. New MTC 5523. 3/25/440/750 Rpm.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

ENGINE-GENERATOR SET



17x21" Lentz Poppet Valve Steam Engine made by Erie City Iron Works, direct connected to Allis-Chalmers Generator, 200 KVA, 200 RPM, AC., 240 volt, 60 cycles, 3 phase, 483 amp., with Allis-Chalmers Exciter connected to the generator with a silent link chain belt — 1100 RPM. Equipped with rheostat for generator and rheostat for exciter.

THE EASTERN MACHINERY CO.

1007 TENNESSEE AVE. CINCINNATI, OHIO

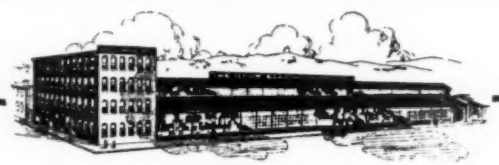
TURBO UNITS—60 CYCLE
1—5000 KW G.E. condensing.
1—3200 KW Allis-Chalmers condensing.
1—2500 KW G.E. condensing.
1— 500 KW West. condensing.
1— 300 KW G.E. non-condensing.

TRANSFORMERS
Single Phase, 60 Cycle.
3—150 KVA Pittsburgh, 6600/220-440 V.
3—100 KVA G.E. 13,200-6600/2200 V.
2— 75 KVA West. 6600/230-460 V.
2— 37½ KVA Pittsburgh 2200/220-440 V.

ELECTRIC MOTORS
3 Phase, 60 Cycle.
1—165 HP G.E. Syn. 2200 volt, 900 RPM.
1—125 HP West. Syn. 2200 volt, 1200 RPM.
1—100 HP Crocker-Wheeler Syn. 220/440 volt, 1200 RPM.
1—100 HP West. Type CW Slip Ring, 2200 volt, 760 RPM.

If you have any equipment for sale, please send us a list.

TIPPINS MACHINERY COMPANY
3528 Forbes St. Pittsburgh, Pa.



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GENERATORS
MOTOR-GENERATOR SETS
ENGINE-GENERATOR UNITS

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Specialists on Rebuilding Motors. Generators and Controls.
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1—100,000 & 50,000 Gal Tanks & Towers
1—33, 66 & 100 KW Gens. D/C Full Diesels
2—300 HP "Taylor" Stokers—Like New
1—150 HP, 125#, Scotch Marine Boiler
2—250 HP, 160#, W. T. Boilers
1—75 Ton Case Overhead Elec. Trav. Crane
1—700 HP 13"x8"x12" Steam Pump
H. & P. MACHINERY CO.
6719 Etzel Ave. St. Louis 14, Mo.

1—400 HP Westinghouse, type CW, 3 ph, 60 cy, 440V, 450 RPM slip ring motor
1—300 HP Westinghouse, 3 ph, 60cy, 440V CW slip ring motor 495 RPM
2—250 HP General Electric, 3 ph, 60 cy, 440V 1-17A 400 RPM
1—200 HP Allis Chalmers, 3-60-440V, 514 RPM
2—150 HP Allis-Chalmers, 3 ph, 60cy, 440V, 450 RPM slip ring
1—150 HP General Electric type KT, fr. 558 3-60-2200V 880 RPM
1—150 HP General Electric, type ATI, 3 ph., 60 cy, 440V 900 RPM, 0.8 PF syn. motor
1—150 HP Electric Mach. syn. motor 125 KVA, 3-60-220V, 1200 RPM
1—150 HP General Electric, 3-60-440V
1—17A 360 RPM slip ring
1—150 HP Westinghouse, 2 ph, 60cy, 440V frame 1000, CW, 390 RPM slip ring
1—150 HP G. E., 3 ph, 60 cy, 440V, 1170 RPM, type I-6
2—125 HP Westinghouse CS774C 3-60-440V 860 RPM Ball Bearing
4—100 HP General Electric, 3-60-440V 495 RPM, MT 562 slip ring
1—100 HP General Electric type I, form K, 3-60-220V 575 RPM

Factory built, 3 bearing, Westinghouse motor-generator set, 16½ KW, 650 amp., 25 volt, 1750 RPM, SK93, generator direct connected to 26 HP, 230 V, DC, SK83 motor with complete panel.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200V, 1750 RPM, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 690 RPM slip ring
1—100 HP, G. E., 3 ph, 60 cy, 440V, 580 RPM, type 1-15
2—75 HP 300 foot head Pumps: 2200V Fairbanks-Morse, 1800 RPM 3 ph, 60 cy, slip ring motors direct connected to 500 GPM 3 stage
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring
1—75 HP Westinghouse, type CW, 3 ph, 60cy, 440V, 720 RPM slip ring, 3 or 2 bearings
1—75 HP Fairbanks-Morse, type H, frame 165C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring
1—75 HP General Electric, 3 ph, 60 cy, 440V, 500 RPM, MT558 slip ring
1—75 HP Western Elec. type I, 3-60-440V, 690 RPM
1—75 HP General Electric, 3-60-440V, type I, 575 RPM
1—75 HP, G. E., 3 ph, 60 cy, 220V, 1165 RPM, type KT-347
3—25/65 HP Westinghouse, frame 762C, 3-60-440V, 600/1200 RPM, 2 speed slip ring motor
1—60 HP General Electric type KT, frame 346, 3 ph, 60 cy, 440V, 870 RPM
1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage 900 RPM
1—60 HP, General Electric, 3-60-440V, 720 RPM, type I form K
1—60 HP General Electric 3-60-440V, 1750 RPM, type I slip ring
1—60 HP General Electric 3-60-440V, KT542, 870 RPM Sq. Cage
1—60 HP, Westinghouse, 3 ph, 60 cy, 220V, 1160 RPM, type CS-644C
1—50 HP Wagner (Fynn Weichsel) 3-60-440V, 1200 RPM
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, KT 346, 870 RPM, Sq. cage
1—50 HP General Electric 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP Howell 3-60-440V 870 RPM, type SCBB ball bearing Sq. Cage
1—50 HP General Electric 3-60-440V, 720 RPM, type I-K, Sq. Cage
2—50 HP Allis-Chalmers 3-60-440V, 690 RPM slip ring
1—50 HP General Electric 3-60-440V, 690 RPM, MTS 46, slip ring
1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring
3—50 HP General Electric 3-60-440V, 575 RPM, type I-K, fr. 13A, Sq. Cage
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers 3-60-440V, 490 RPM, Sq. Cage
1—50 HP General Electric 3-60-440V, 490 RPM, type I-M, slip ring
1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP Allis-Chalmers, 3 ph, 60 cy, 220V, 1160 RPM, type AR-220D
1—50 HP, Howell, 3 ph, 60 cy, 440V, 1165 RPM, type SC50-4, ball bearing

We have a stock of 3000 motors from 1 HP to 50 HP in AC and DC. We have a very large stock of air circuit breakers up to 12000 amp.

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM
1—60 HP Westinghouse, type SK, frame 160, 230V, 680 RPM
1—60 HP Westinghouse type SK140L, 115V, 1150 RPM vertical
1—50 HP Westinghouse, type SK, fr. 160, 230V, 565 RPM
1—50 HP Westinghouse SK200, 245 RPM 230V
1—DC Generator 45KW Bullock 120V, 375A, 900 RPM
2—40 HP C & C 230V, 250/1000 (planer)
2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25cy-440V, 720 RPM, type MS, Sq. Cage
1—50 HP General Electric, 3-25cy-440V, 700 RPM, type I-M, slip ring
1—40 HP Westinghouse 3-25cy-440V, 730 RPM, type CI, frame 753A slip ring crane
1—35 HP Allis-Chalmers 3-25cy-440V, 720 RPM, slip ring
1—30 HP Westinghouse 3-25cy-440V, 720 RPM, CS, Sq. Cage
2—30 HP, Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 12B ball bearing
1—30 HP, Wagner, 3 ph, 60 cy, 440V, 900 RPM, type 19TCM, totally enclosed fan cooled, ball bearing

The Wente Electric Co.,

Hamilton, Ohio

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250 VOLT ROTARY CONVERTERS

1—1500 KW., Westinghouse compound interpole 250 v. D.C., 6 phase, 60 cycle AC Rotary converter, 600 RPM.

3 single phase, 2300 Volt transformers 1—DC and 1—AC panel for above.

2—1000 KW., Westinghouse compound interpole 250 volt DC, 6 phase, 60 cycle AC Rotary converter, 900 RPM.

2—Banks of 3 single phase, 2300 volt transformers for above and 2—DC and 2—AC panels.

The above in excellent condition.

1—3120-4030 KVA, 240-310 volts, 167 RPM, 6 phase, 25 cycle, General Electric Rotary, with transformers.

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries. What have you for sale?

Keystone Power Plant Equipment Co.

8403 Hegerman St., Philadelphia 36, Pa.

SYNCHRONOUS CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A. C. 1200 RPM
500 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

360 KW G.E. SYN.250 V. 2300/4000 A.C.1200 RPM
300 KW WEST.SYN.250 V.2300/4000 A.C.1200 RPM
200 KW G.E. IND. 600 V. 2300 A.C. 1200 RPM
200 KW R.W.SYN. 250 V.2300/4000 A.C.900 RPM

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Generator for sale

875 KVA. West. AC 300 RPM with Exciter and extension shaft.

Stephen A. Douglass Co.

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SQUIRREL CAGE MOTORS
(3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
700	G.E.	6600	1800	
400	West.	2200	600	CS
125/40	CR. Wh.	2200	700	125AQ
125	Burke	220/440	1200	
125	Cr. Wh.	2200	700	125AQ
60	G.E.	220/440	720	I-K

DC SERIES & CPD. MOTORS

HP	Make	Type	Speed
2	R & M	122	1000
5	R & M	125	1000
15	West.		650
25	Shaw		600
25	G.E.	CO 2002	600
50	Shaw		600
50	G.E.	RCP	1750
50	G.E.	CD115	850
50	Ai. Ch.		700
100	G.E.	MD 108	480
130	G.E.	CO 1812	550
175	G.E.	MD8 190¼	475

SLIP RING MOTORS, (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
1000	Ai. Ch.	440	235	
700	G.E.	2200	393	MT 342
200	G.E.	2200	240	MT 412
150	G.E.	220/440	720	I-M
150	Ai. Ch.	2200	685	
150	G.E.	220	575	I-M
125	Ai. Ch.	2200	435	
100	Ai. Ch.	220/440	575	
100	G.E.-25 cy.	220/440	500	MI-108
75	G.E.	2200	695	I-M

"Wound Rotor Motors" (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
200	G.E.	2200	600	I-L
150	G.E.	2200	600	I-L

TRANSFORMERS

Qu.	KVA	Make	Voltage
2	25	G.E.	2200/244/488
3	37	West.	4400/185
3	37½	West.	2200/440/220
1	37½	Pgh.	2200/110/220
3	50	G.E.	22000/2200
3	75	G.E.	2300/110/230
3	100	Uptegraff	440/820

OIL ENGINE DRIVE AIR COMPRESSORS

Chicago Pneumatic simplate valve type, N503 straight line 16½ & 11 x 18" capacity 492 cu. ft. displacement, 100# pressure, with air receiver and starting air compressor.
2—14x10" Sullivan 505 cu. ft. compressors.
1—10x12 Ch. Pneu. 164 cu. ft. steam compressor.

M-G SETS 3 ph. 60 cy. (Syn.)

150 KW West. 550 v. DC—2200 AC 900 RPM.
65 KW G.E. 250 v. 1200 RPM—100 HP 220/440 v. AC

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4—6 Ton G.E. Storage Battery Loco. 44" Ga. with Batteries (Can change to 36" Ga.)
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2—4' x 5' Tyler Hummer Screens with Vibrator.

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SOLVE YOUR COAL STORAGE PROBLEM WITH OUR 50-TON HOPPER CARS AND ALSO HAVE MOBILE STORAGE. MORE FLEXIBLE AND MONEY-SAVING TOO!

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1—7500 KW. 5000 v. 60 Cy. 3 Ph. TURBO with Surface Condenser

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1—3000 KW. TURBO 60 Cy. 3 Ph. 480 v.
HEAT EXCHANGER 606 tubes 1¼" x 9'6"
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24" Back Pressure Valve F&D
75 Ton Crane 65 span—25 Ton 50' span
200 KW. and 125 KW. ENGINE SETS (230 V. 60 Cy. 3 Ph. with Auxls.)
453 NEW STIRLING BOILER TUBES 9 GA.

1—New FAN 66750 CFM 2" to 6" Pres.

4—CENT. PUMPS 4166 GPM. 162' Head with 440 v. 60 Cy. 3 Ph. AC. Motors
1—36000 GPM, 27' head CENT. PUMPS
3—20" Brass fitted F&D Valves.
TRAVELING CRANE 75 ton Case, 64' span, 3 motors. Also others.
750 KW. and 110 KW. AC HYDRO ELEC. PLANTS and others.
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ROSS POWER EQUIPMENT CO., Indianapolis, Ind.

STEAM PUMPING ENGINES

1—Snow 6 mgd. C&FW Cr. Com. Opp. Type Cond. 20-40x14½x36, with waterwork type cond.
1—Allis-Chal. 4 mgd. cr. com. cond. also 12x28x13x24. Fine cond.

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Birch Valves for reciprocating pumps.

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4—48" Chapman Motor operated solid wedge gate valves non-rising stem.
1—20" Rensselaer #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod & Eyebolt, 100#
1—20" Crane 125# Flanged Hand Wheel operating Gate Valve.

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1—10 AD 4 pass 210 ft. Foster Wheeler *over* Comb. Air Circulating and Tail Pump.

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COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

For EXPORT or DOMESTIC USE

BOILERS: 2500 HP, 1500, 1460, 800, 750, 680, 620, 565, 500, 400, 250, 200 HP:—Makes—B&W, Heine, Edge Moor & Others

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100 H.P. G.E. synchronous motor type T.S. serial #5504251, direct connected exciter, 440 volt., 3 phase, 60 cycles, 1200 R.P.M., starting equipment.

30 H.P. Star Electric motor style SY-504, ballbearing, serial #231362, 220 volt, 3 phase, 60 cycles, 685 R.P.M., Cutler Hammer variable speed controls.

DENNY & CLARK

910 N. Marshfield Ave., Chicago, Ill.

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250 KW 125 V. 320 RPM with 4 cyl. 11 x 12 vertical uniflow steam engine, equal to new unit.
NEW 400 H.P. 4 cyl. 11 x 10 Vertical Uniflow steam engine bare unit. Supply any generator.
50 KW GE 125/250 V. Marine Set.
200 K. W. 125 V. or 250 V. Skinner Uniflow engine.
750 K.W. 250 V. 720 R.P.M. interpole generator.
740 KW 250 V. induction bleeder turbo set, geared.
Boilers of all sizes, stokers, oil burners.
Turbine Sets, A.C. and D.C. to 1000 K.W.
Diesels of all sizes, large and small.

Send your lists of equipment

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50 CHURCH ST. NEW YORK

1—125 H.P. 350 lb. Loco portable type boiler
1—150 H.P. 100 lb. Loco portable type boiler
1—5A Iron Fireman Stoker 120 lb. capacity
2—26"x65' high bell bottom self-supporting steel stacks
2—54"D. 8' 9" high vertical 150 lb. pressure boilers
1—6' x 12' air cushion tank 250 lb.

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Phone VanBuren 8669

FOR SALE

One 100 K. W. 250 volt D. C. Turbo Generator Turbine-Curtis Form C, 2 stage 3600 R.P.M. 150# S.W.P.
Generator—100 K. W. General Electric Type MFC, Class 4-100-3600 Form T, 400 Amps 250 volts D. C.

PILOT MARINE CORP.

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FOR SALE

A. C. Generator—General Electric Engine type with direct connected exciter mounted on flanged shaft. 200 K. W., 3 phase, 277 R. P. M., 240 volts, for Diesel engine drive.

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Post Office Box 408 Red Bank, N. J.

Steam Engine Driven Units

1—200 KVA, 60 Cycle, 3 Phase, 2400 Volt Alternator.
3—150 KW D.C. Generators.

Can be seen in operation

FS-587, Power
520 No. Michigan Ave., Chicago 11, Ill.

SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
700	2200	G.E.	900
400 (2)	400	Whse.	514
350	220–440	G.E.	1800
350	2200	G.E.	600
300	2300–4000	G.E.	1200
300	440–550	G.E.	600
250	2200–550	G.E.	1800
200	2200–400	G.E.	600
200	440–220	G.E.	1800
150	2200	G.E.	900
150	2200–440	Whse.	1800
150	550–2200	G.E.	1800
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
75	220–440	G.E.	600

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

600	2200	Whse.	900
400	440–220	Whse.	276
350	440–220	G.E.	900
240	2300–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
100	440–220	G.E.	1200

PUMP

1—8" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

AIR COMPRESSOR

1—465 CFM Ing. Rand Motor Driven Air Compressor Unit Type XRB 8" x 13" x 10" 300 RPM—100# Gu. No. 89242-3 driven by 75 HP GE AC Motor complete all Accessories including Receiver.

TRANSFORMERS—60 CYCLE

3—667 kva., G.E., 2300/4000-460/480 Volts.
3—667 kva., Whse, 22000-2300.
3—500 kva., Whse., 22000-2300.
3—350 kva., G.E., type H-KD 13200-2300.
3—333 kva., G.E., type H-KDD 2400-460/230.
3—250 kva., Whse. 13,800-460.
3—200 kva., G.E., type H 10000-600.
3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E., 4000-480.
3—150 kva., G.E., type H-KDD 13200/2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva , Whse. 22,000-2300.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse. type SK, 13800-240/120.
3— 50 kva., Whse. 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200	Whse.	C.S.	1800
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
200	220/440	G.E.	IK	720
150	2200	Allis. Ch.	AN	450
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E.	K	1800

MOTOR GENERATOR SETS

75 KW, 125 V, 1200 RPM Westinghouse Conn. to 112 H.P. 2300/440 V, 3 ph, 60 cy. Ind. motor.
1—75 KW 125 V. 1200 RPM, GE Conn to 100 HP 440 V. 3 ph. 60 cy. Ind. motor.
1—75 KW. 250 V. 1800 RPM, Cr. Wh., Type CCD con. to 100 H.P., 2200 V., 3 ph., 60 cy.
1—250 KW Motor Generator Set, very modern, practically new, see further description under that heading.

A.C. GENERATORS

1—500 kva., 900 r.p.m., 2200 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—225 kva., 600 r.p.m., 2200-240 V., G.E.
1—187 kva., 900 r.p.m., 2200-550 V., Westghse.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

POWER PLANT EQUIPMENT

TURBO GENERATORS

5000 KW GE Cond. 2300 volts
2500 KW GE Cond. 2300 volts
2000 KW GE Cond. 600 volts
600 KW GE Cond. 600 volts
500 KW GE Extract, 600 volts
200 KW GE Cond. 2300 volts
150 KW West Non-Cond. 600 volts

TURBINES ONLY

230 HP Terry—150 lbs.
210 HP Terry—250 lbs.
175 HP GE—110 lbs.

AIR COMPRESSORS

610 CuFt IR Motor Driven
600 CuFt IR 500# Steam Driven
275 CuFt IR 110# Steam Driven
146 CuFt IR 1200# Belted

CENTRIFUGAL COMPRESSOR

10,000 CuFt—35# Turbine Driven
7,000 CuFt 21.7# Turbine Driven

BOILERS

1—750 HP Heine—200# Stoker
5—318 HP Manning Type—190#
2—303 HP Sterling—160#
2—255 HP H.R.T. 150# Stoker
2—235 HP H.R.T. 175# Grates
2—200 HP H.R.T. 100# Grates
2—100 HP H.R.T. 125# Grates
1—400 HP Sterling 160# Stoker

CRANES

1—15 Ton 35' Span Hand Operated
1—25 Ton 53' Span Hand Operated

Also transformers, engines and cranes

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A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

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POWER PLANT EQUIPMENT

BOILERS and STOKERS

6—B. & W. Boilers 400, 500, 750 H.P. with Stokers, 200# pressure

All the above boilers have superheaters. 18 Stokers from 400 to 1000 H.P.

TURBO GENERATORS from 500 to 15000 K.W.

Diamond Soot Blowers, 38 sets, 2" x 2½" valve in head

We specialize in high pressure boiler fittings, Boiler-Supports Superheaters pop safety valves, blow-off valves, steel headers, steam valves up to 600 lbs. up to 24" in diameter, turbine and motor driven boiler feed boilers—high and low pressure pumps.

Also have in stock oil circuit breakers up to 3,000 amps. and 74,000 volts—disconnect switches up to 6000 amps.

Stock of 5,000 current and potential transformers of all sizes, all kinds of relays, overload, underload, heat element, etc.

We also buy complete plants outright. What have you for sale?

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Telephone Nos. Worth 2-2708—2709—2710

120 KW ENGINE GENERATORS SET

1—120 KW G.E. Co. Type TRE Generator, 3/60/2300 volts, direct connected to 125# Harrisburg Fleming Steam Engine.

HOIST

1—50 HP Lidgerwood Double Drum Hoist, 24 x 24" drums, side by side, with or without AC or DC motor.

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2—600 GPM, 116 ft. head, Kingsford, size #4 Deep Well Pumps with 40 HP G. E. Co. Type CD-93, 230 V. DC vertical motors.

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3—Size 36" x 48" Link Belt Double Roll Coal Crushers, product size 1½" to 3", spring relief type.

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MOTOR GENERATOR SETS
ROTARY CONVERTERS
SWITCHBOARDS BUILT TO ORDER

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2—150 HP W.E. Co. Type G, 80% P.F. for 3/60/220-440 volts, 1200 RPM, with direct connected exciters.
2—250 HP W.E. Co. Type HR, 100% P.F. for 3/60/2300 volts. Engine Type, one (1) at 240 RPM, one (1) at 277 RPM.

100 KW ROTARY CONVERTER

1—100 KW G.E. Co. Type TCC for 250 V—DC and 3/60/2300 V—AC. Transformer and Switchgear. 1200 RPM.

CENTRIFUGAL PUMPS

2—2700 GPM, 170 ft. head Lecourtnay Centrifugal Pumps driven by 150 HP W.E. Co. Type G, 80% P.F. Synch. motors 3/60/220-440 volts, 1200 RPM.

PLATFORM SCALE

1—15 ton Fairbanks Industrial Platform Scale, 5' x 8'.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

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Turbines, Electrical Equipment, Refrigerating Equipment, Pumps and auxiliaries.

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Must be Sold

(Located at Cushing, Okla.) 1—B&W, Stirling water tube Boiler—250 H.P., 140# pressure—Model H3—#14 Buillt 1929—238—3¼" tubes with steel stack.

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(Located at Gilmore City, Iowa) 4—Bonus-Freeman water tube Boilers—320 H.P. 160# pressure. Each—144-4" tubes 18' long.

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Specials, all ASME

253 HP Class H-3, #14, 150# Stirling.

1—300 HP 200# & 1—356 HP 180# Class S Stirlings.

LARGE MOTOR AND PUMP BARGAINS

For Immediate Delivery

G. E. ELECTRIC MOTORS

9—2500 H.P. General Electric Induction Motors. Motor Numbers: 5283038, 5283041, 5283042, 5283043, 5283044, 5283046, 5283047, 5283048, 5283049, 5283050. Type MT-28-2500-257. Form AE, 60-cycle, 3-phase, 6600 Volts, 202-amp., secondary volts 706, secondary amps. 1530, speed full load 253 R.P.M., continuous rise 40 degree centigrade. With Starting Equipment.

1—1500 H.P. General Electric Induction Motor, No. 5393731, Type MT-28-2500-257, Form AE, 60-cycle, 3 phase, 6600 Volts. Complete with Starting Equipment.

PUMPS—Hydraulic

7—Hydraulic, Centrifugal, 33" intake and 28" discharge, complete with impeller, front and back doors; with Thrust Bearing and Shafts.

4—Pumps, National Transit, No. 49075, HORIZONTAL DUPLEX PISTON PUMP, capacity 120 G.M.P. at 415 foot head, size 4½" x 10", with motors and accessories.

2—Pumps, Vertical Centrifugal, Yeoman Bros., 4" x 4" 50" overall height of pump, single-stage, 400 G.P.M. at 250 foot head. Accessories.

2—Pumps, National Transit, No. 49073, Horizontal Duplex Piston Pump, size 5½" x 10", capacity 180 G.P.M. at 180 foot head with motors & Accessories.

TRANSFORMERS

15—25-KVA Transformers, Distribution, G. E., Type H, Form KR, Addative polarity, single-phase, 60 cycle, 5940/6600/11430Y to 230 volts, continuous 55 degree centigrade rise, diagram No. 3978194, approximately 3.6% impedance at 6600 volts and 75 degrees centigrade, capacity 31 gallons of 10-C transil oil. Instructions GEJ-56.

6—15-KVA Transformers, Distribution, G. E., Type H, Form KR, Addative polarity, single-phase, 60 cycle, 59/6600/11430Y, to 115 Volts, Cap. 16 Gal., 10-C transil oil.

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5—Pacific heating boilers, 32 to 14,000'
1—Each 12-25-40 HP Scotch Marines
1—Each 25-40-75-150 HP Fire box
2—150 HP HRT's—125# all fittings
1—500 HP Heine type "E" stoker 350#
1—250 HP Heine type "E" stoker 165#
1—750 HP Sterling and stoker 250#
2—150 HP Worm type stokers

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1—W.T. 600 H.P. Boiler, Standard 143, B & W Stirling type. Allowable pressure after reinstallation 163 pounds. Recommended operation 175% of capacity.

1—Taylor stoker (A.E. Company) for above boiler.

FS-584, Power,
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FOR SALE

150 KW Western Electric direct current generator set, direct connected to an Erie Ball engine, 230 volts, two wire set.

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COMPLETE DIESEL ELECTRIC PLANT

One 60 H.P., 6 cylinder, Caterpillar Diesel with auxiliary starting engine.

One 37.5 KVA, 60 cycles, Star Electric Generator, equipped with Meter and Panel Board. Entire unit equipped with automatic safety devices and vibration isolators.

May be seen in operation Monday through Friday, 10 A.M. to 5 P.M.

Attention Mr. Levin

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400 H.P. INGERSOLL-RAND FULL DIESEL ENGINE 6 Cylinder, 4 cycle, 300 RPM. Including spare parts.

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Boilers 250# pressure, 800-500-250 H.P.
Scotch marine—locomotive type 150 H.P.
Stacks—54"-48"—100 feet high.
Gas-gasoline-Diesel Engines & Generators.

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1—WORTHINGTON DIESEL MOTOR and G.E. GENERATOR A-C SET,

66 KW, 82 KVA, 60 cycle, 3-phase, 2300-volt, speed 327 RPM; good condition.

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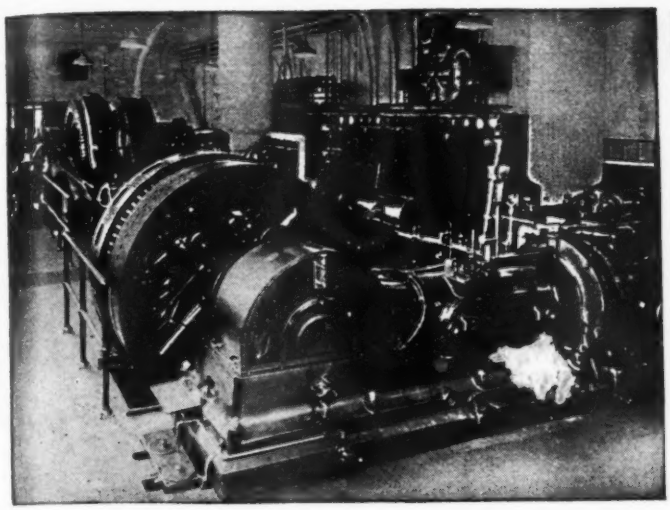

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Subject to prior sale following equipment will be sold for 50% of present market prices.

2 Skinner Uniflow Engines with Westinghouse Generators and Exciters rated 1000 and 62½ KVA both 440 V-60 C- 3 Ph.

Sell as unit or separately. Plant open for inspection. Can operate for interested parties.

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1200 Amp. 3 pole Fused Safety Switch.

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2500 and 5000 Amp. 230 Volt Air Breakers Solenoid Operated, Single Pole.

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New Water and Dust Tight Push Button Stations.

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Water tight and dust tight, two-speed controls from 1 to 30 H.P.

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100 Kw. Wsghse SK, 900 RPM, 230 V. D.C.

METERS

Gen. Elec. Type H, Edgewise

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5 Amp. to 2000 Amp.

Magnetics and Contactors.

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ELECTRIC MOTOR & MACHINERY CO.

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POWER PLANT, with 2, 300 H.P. Boilers complete with 2,500 KW 3/60/2300 Turbines
2—300 H.P. Water Tube Boilers
1—453 H.P. 160# Stirling W. T. Boiler
1— 47 H.P. Vert., 60" dia., A.S.M.E. 150#

COMPRESSORS

248 CFM Chi Pneu with 50 H.P. A.C. Motor
526 CFM Ingersoll-Rand, belt drive
780 CFM Chi-Pneu with 125 H.P. A.C. Motor
990 CFM Sullivan with 160 H.P. A.C. Motor

MOTORS

3 H.P. to 75 H.P.—A.C. & D.C. Units
(Write for our complete electrical list!)

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300 H.P. Buckeye Diesel Eng. & Gen., 3/60/240
500 KW G.E. Skinner Uniflow Steam Eng. Gen. 250 D.C.
100 KW G.E. Type ATB-2-1250-3600, 3/60/2200-900
5000 KW Turbo Generator, 3/60/2300-3600 RPM
POWER PLANT—Complete with 2, 625 KW Turbo Gen.

1000 KW Frequency CHANGER SET
25 to 60 cycles

60 cycle unit 4150 V. 25 cycle unit 9000 V.
Complete with starting equipment.

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Superior Iron Works, sgl. drum, 36" dia. with 80 H.P. G.E. Type MTC motor.
1 to 4 ton cap. sgl. monorail type hoists.

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"Anything containing IRON or STEEL"

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1	35	West.	SK	300/1200	2	10	El. Dyn.	5S	600/1200
2	35	West.	SK	500/1500	1	10	West.	SK	500/1500
6	30	West.	SK-130	600/1200	1	11½	West.	SK	600/1200
1	30	West.	SK-130	600/1800	3	10	G. E.	RLC	400/1200
1	25	G. E.	RF-14	300/1200	1	7½	El. Dyn.		450/1350
1	20	G. E.	RLC	500/1500	2	7½	West.	SK-53	600/1800
1	20	West.	SK-130	375/1500	3	7½	G. E.	RF-9	600/1800
3	15	West.	SK-103	500/1500	1	7½	El. Dyn.	S7½	300/1200
1	15	West.	SK-163	187/300	1	7½	West.	SK-143	160/270
1	15	Sprague	LC	500/1100	7	5	West.	SK-70L	400/1600
1	10	West.	SK-90	400/1600	3	5	Reliance		600/1800
1	10	G. E.	RF-10	400/1600	6	3½	West.	SK-40	450/1800
9	10	Reliance	78T	500/1500	6	3	West.	SK-43	500/2000

KULLER & CHISWICK 245 CENTRE STREET, NEW YORK CITY (13) N. Y.
CANAL 6-6033

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1—470 H.P. Edgemoor water tube type Boiler A.S.M.E. 160# pressure. Immediate delivery. Location, Chester, Pa.

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PUMPS

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3000	40′	Cameron	Centrif.
300	500′	Goulds	Triplex
240	460′	Worth.	Triplex
175	500′	Worth.	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
200	175′	Blackmer	Rotary
1500	460′	Platt	Steam
1000	460′	Knowles	Steam
600	460′	Knowles	Steam
2000	60′	Lawrence	Sump
300	231′	Gardner	Plunger

STEAM ENGINE GENERATOR SETS D.C.

K.W.	Make	Volts	Type
50	G.E.	250	dir. dr. Eng.
35	Sturt.	250	belt dr.
25	Greenfield	115	belt dr.
25	G.E.	115	dir. dr.
2	Erie	115	dir. dr.
1	Moon	115	St. Turbine

MOTORS (D.C.)

100	Northwest.	220	1750
25	Imperial	220	450
25KW	Fair. Morse	110	1050

STORAGE TANKS

5 to 30000 Gal. Steel welded
5 to 1000 Gal. Steel Press.
15 to 300 Gal. Conden. Tanks

CONDENSATION RETURN UNITS

Nash-Jenn. Dup. Vac. Heat. 26000EDR.
Nash-Jenn. Simp. Vac. Heat. 16000EDR
Skidmore Vac. Heat. 20000EDR
Skidmore Vac. Heat. 8000EDR
Condensation Units 100 to 250,000EDR

AIR COMPRESSORS

C.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing.	Horiz.
250	100	Ing. Rand	Horiz.
220	100	Gardner	Gas. Eng.

TURBO-CENTRIFUGAL

3000	16 lbs.	In. Rand	Motor dr.
2300	3 lbs.	Spencer	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
1500	16 oz.	Spencer	Motor dr.
1200	16 oz.	Spencer	Motor dr.
750	16 oz.	Spencer	Motor dr.
400	16 oz.	Spencer	Motor dr.

BLOWERS

C.F.M.	St. Press	Make	Type
100-60000	1/4"-5"		Various
100-15000	1/4"-16 oz.		Various

ROTARY PRESSURE BLOWERS

10000	2 lbs.	Roots	Belt. dr.
6000	3 lbs.	Roots	Belt. dr.
3000	3 lbs.	Roots	Belt. dr.
2000	3 lbs.	Sturt.	Belt. dr.
1000	3 lbs.	Roots	Belt. dr.
200	5 lbs.	Baker	Dir. dr.
110	15 lbs.	Beach R.	Belt. dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt. dr.
350	27 in.	Worth.	Belt. dr.
300	27 in.	Nash	Belt. dr.
100	27 in.	Deane	Belt. dr.
200	29 in.	Devine	Belt. dr.

MOTORS (3 ph. 60 cy.)

H.P.	Make	Volts	Speed	Type
300	G.E.	230/4000	1800	Syn.
200	West.	440	690	HF
175	G.E.	440	1150	I
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	343
30	Wagner	220	850	sl. rg.
30	Wagner	220	1150	

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HIGHEST PRICES PAID FOR YOUR SURPLUS EQUIPMENT

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3"x4" Erie Vertical
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EBASCO SERVICES INCORPORATED
Two Rector St. New York, N. Y.

2—500 KVA 3 Phase, 60 cycle, 21000/11000 pri. to 600/480 V. sec. GE type HT form DD, outdoor type oil-cooled Transformers with 3-5% taps on primary
1—275 HP 600 RPM 440 V 3 Brg. GE type ATI Synchronous Motor with startg. eqt.
1—125 KW 440 V 3 Phase AC Gen. dir. con. to 10" x 10" Chuse horiz. 1 cyl. vert. steam eng. and sw. brd.

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Illinois Forced Draft Chain Grate Stoker, with All Accessories, Suitable for burning bituminous coal 150 sq. ft. grate surface, drive 10 H.P. coupled to Reeves drive. No. 8 American Forced Draft Fan for 5¼ x 6 American Blower, engine included. Also Cochrane Open Type Boiler Feed Water Heater of approximately 25 H.P. and equipped with trays.

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Two Taylor 10 Retort Type AA6 Stokers for 1000 HP boilers each. Will rebuild these into smaller stokers or sell for repair parts to suit your requirements.

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HIGHLY EFFICIENT

5000 KW

TURBO-GENERATOR

FOR SALE

GOOD CONDITION

LOW PRICE

60 cycle—3 phase—2300 volts
Condensing

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STOKERS

Two—Four Retort Riley Self-Dumping Underfeed Stokers

One—6 ft. Sturtevant, single width steel plate fan

One—7"x6" Troy Vertical enclosed Steam Engine

Metal & Thermit Corporation
Carteret, New Jersey

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Reconditioned Diesel—Steam—Natural Gas Engines, Boilers, any type and h.p. Reconditioned Pipe, Valves and Fittings. High Tensile Steel Rods. Contact us before you buy.

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Incorporated
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Magnolia 5586

ELECTROLYTIC GENERATOR

400 KW Westgh. Belted D. C. Generator
40/200 Volts—2000 Amps.—650 RPM
3 Bearings
In First Class Condition

IMMEDIATE SHIPMENT

Arthur S. Partridge St. Louis 415 Pine

ROTARY CONVERTER

1—Westghse, 100 kw., 250 v. D.C., 400 amp. D.C., 2 ph., 60 cy., 1200 r.p.m., with Field Rheostat, Oscillating and speed limit device, starting switch and two Westghse, Type SKR, 50 kva Transformers, 2300/2185/2070 v. to 189/55 v., 60 cy. Can be Scott-Connected.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines generators, new or used.

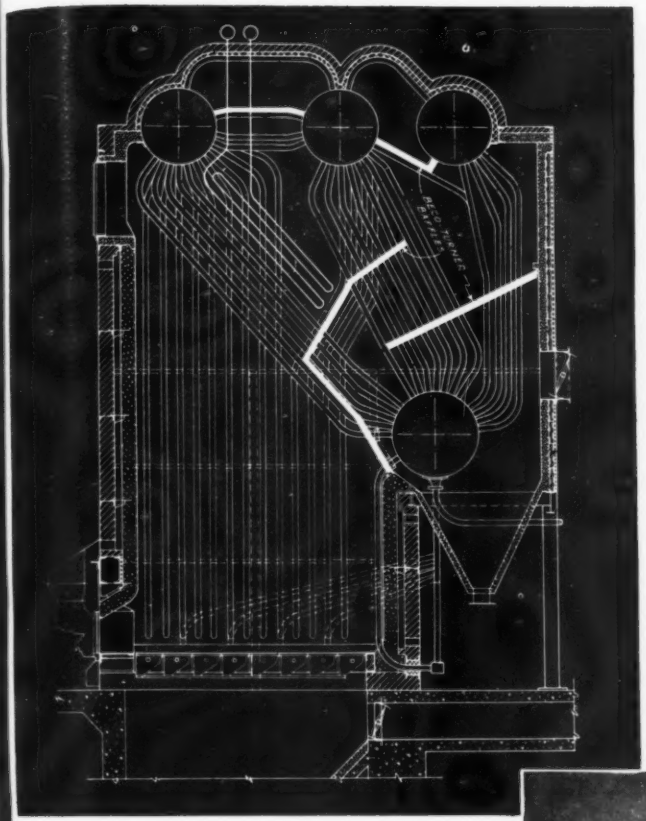
PENN MACHINERY COMPANY
Jackson, Miss.

FOR SALE CHEAP

3 Gas Engines—2 Winton, 1 automatic, 125 H.P. each; also one Cassey-Hodges Water tube boiler. All needing some repairs. Located in Corpus Christi, Texas.

Jones Investment Company
3710 Commerce St., Dallas, Texas

The RIGHT Combination—



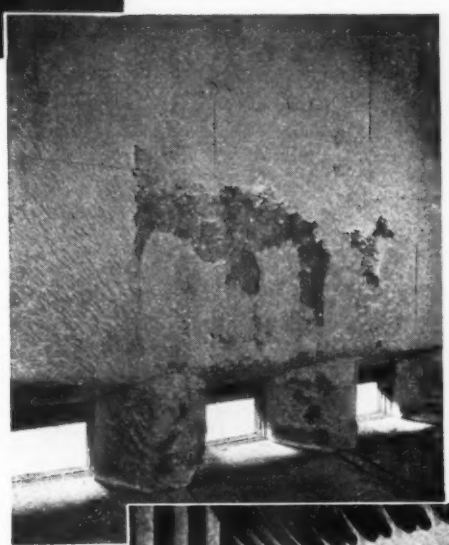
PLIBRICO SETTING

HERE is the *ultimate* in boiler setting construction —this sectionally-supported, air-cooled Plibrico setting is in service at the big Western Ave. Roundhouse of the Chicago, Milwaukee, St. Paul & Pacific R. R. in Chicago.

The story of this installation is the familiar Plibrico success story: The original setting proved so satisfactory that fifteen months later an identical setting was erected.

The print opposite shows details of these Plibrico settings for the two 638 hp. bent-tube boilers with Firite spreader stokers. The firebox walls are constructed of Plibrico Jointless Firebrick; the boiler passes beyond the firebox are lined with Plicast castable refractory. In this installation, you see Plibrico refractories, engineering, and construction in their highest development.

Print above shows Plibrico sectionally-supported, air-cooled walls in firebox; Plicast castable refractory for lining boiler passes beyond firebox; and Beco-Turner cross baffles. Note how location of baffle in front of mud drum eliminates usual soot pocket at this point.



● Photo opposite shows the monolithic Plibrico front wall in connection with first boiler after a full year of service at high rating. Under the slag accumulation, the Plibrico lining is in perfect condition.

—and BECO-TURNER BAFFLES

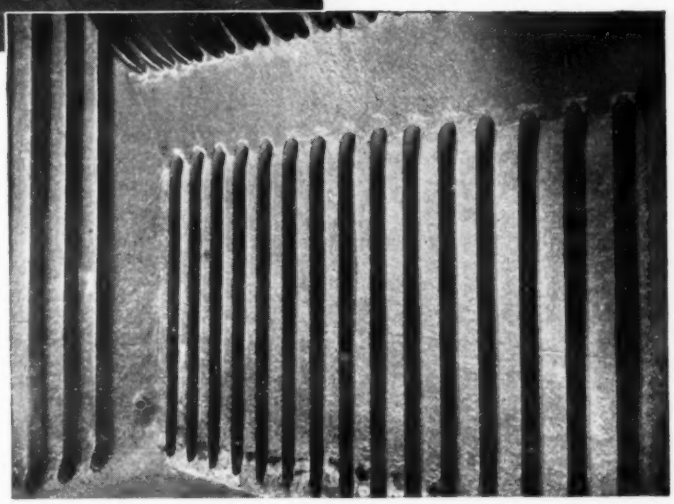
The finishing touch to these modern settings is the Beco-Turner cross baffles, engineered to effect maximum economy and constructed to eliminate the cracks and leaks of ordinary baffle construction.

Plibrico refractories and Beco-Turner baffles are the *right* combination for *your* water tube boiler. They are immediately available without delays for special tile shapes or critical materials.

Plibrico Jointless Firebrick is stocked in over 100 cities throughout the U. S. and Canada. It is ideal for complete settings or simple patching. Write for catalog; specify water tube or H.R.T. boilers.

PLIBRICO JOINTLESS FIREBRICK CO.
1818 Kingsbury Street, (Dept. J) Chicago 14, Illinois

● Shown below is the rear wall of first setting showing Plibrico lining behind water wall. Area above water wall is lower section of Beco-Turner baffle.



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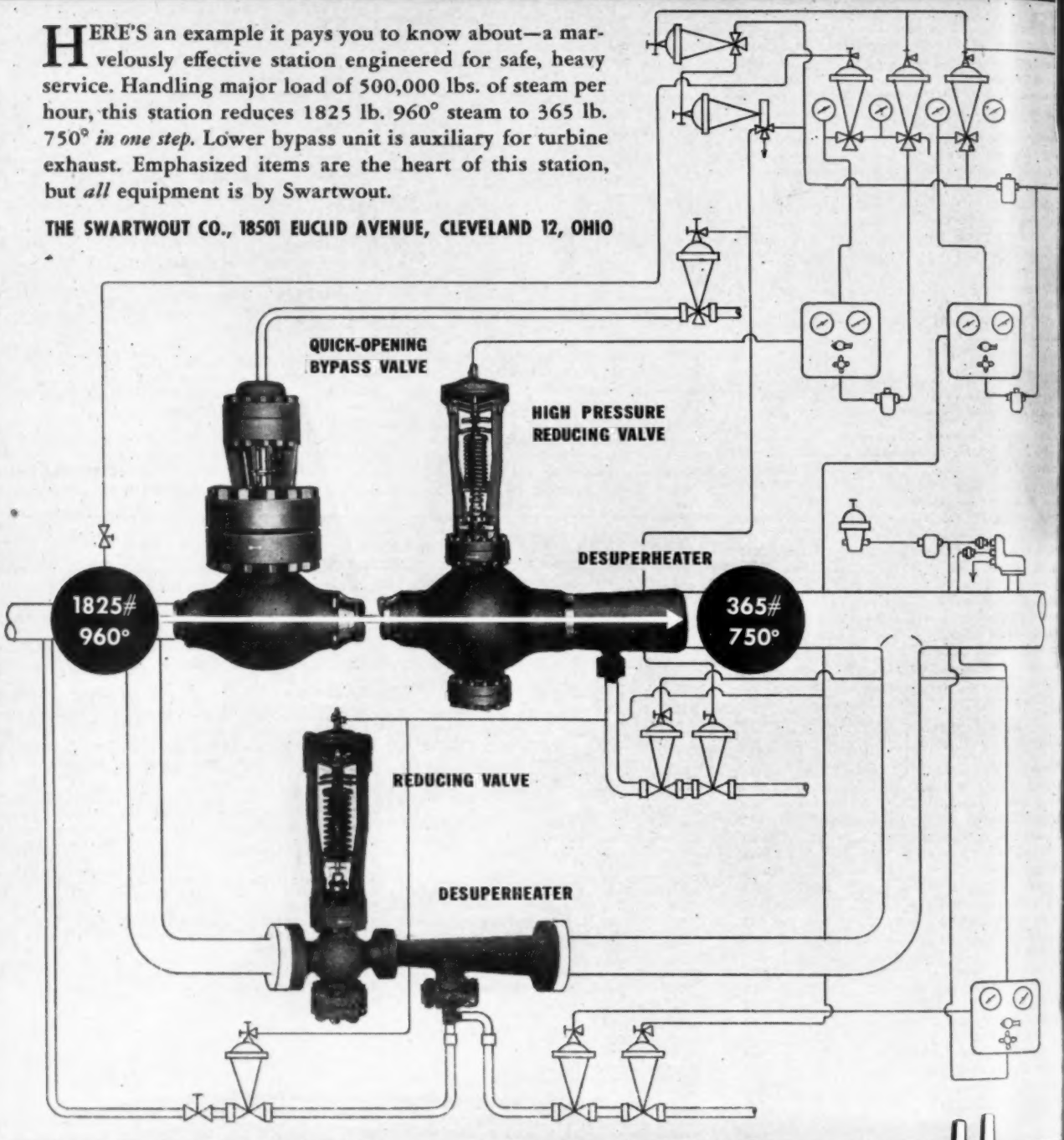

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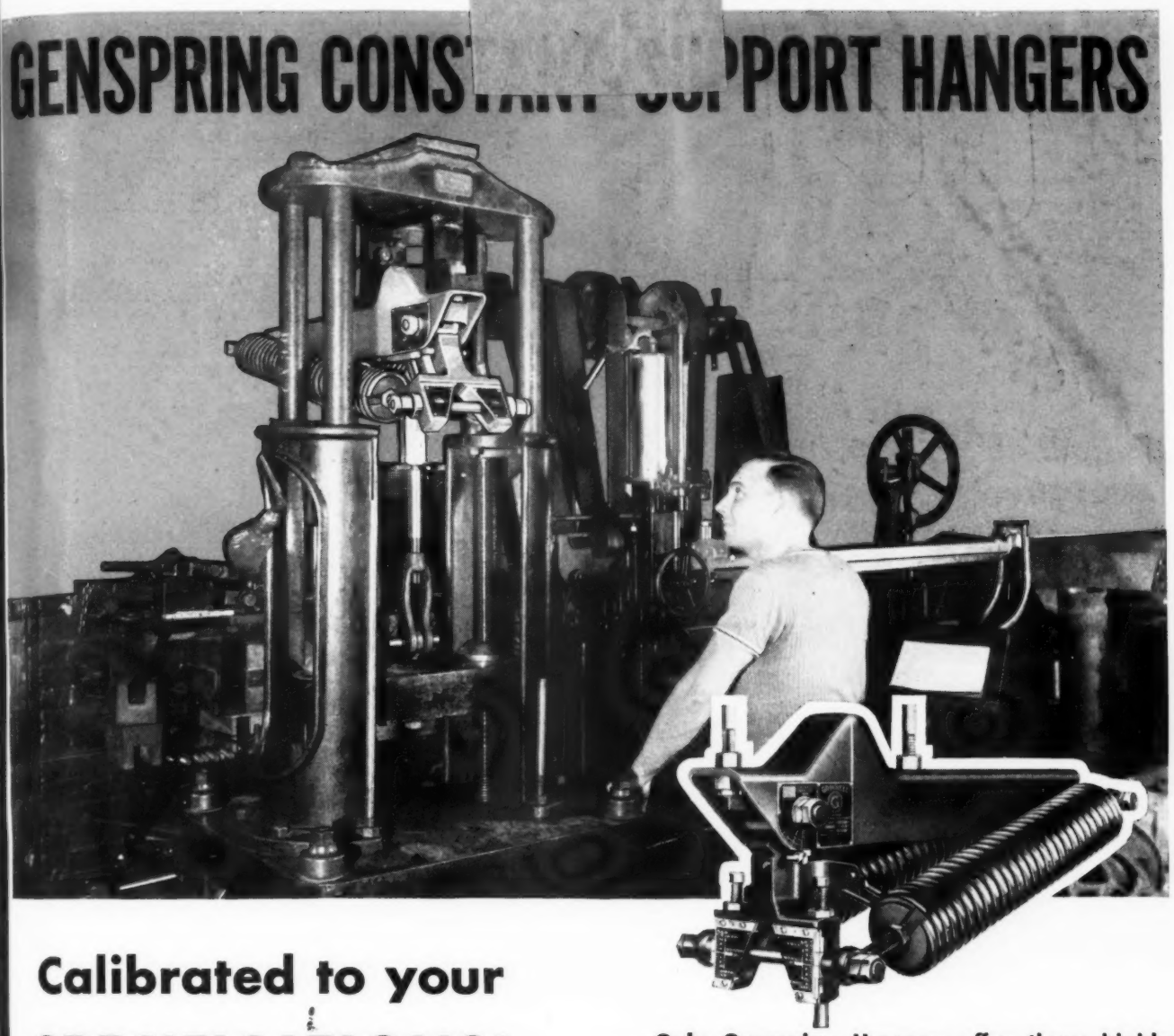

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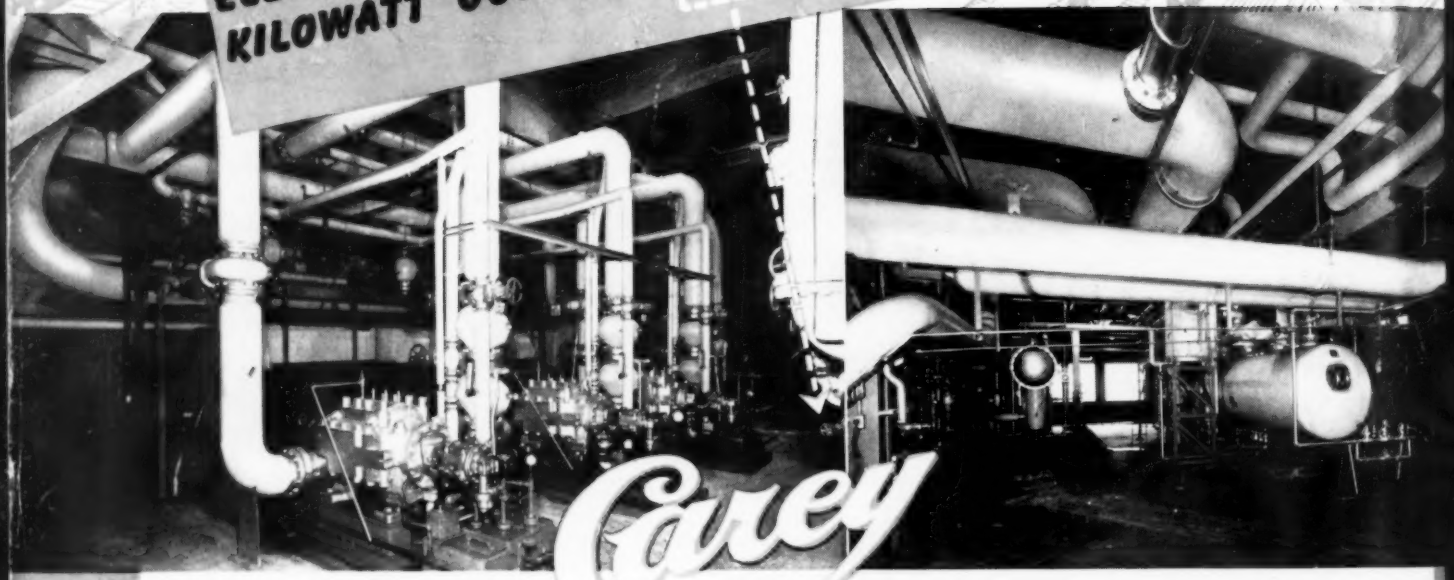

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